

HORTICULTURAL ABSTRACTS.

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Abstracts. Initialled abstracts in this number are by D. N. Srivastava, B.Sc. of Agra University, U.P., India, and by H. L. Pearse, W. S. Rogers and H. Shaw of the East Malling Research Station, England.

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Horticultural Abstracts

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HORTICULTURE—MISCELLANEOUS.

255. THOMAS, M. 577.15.04 : 634/5
Plant hormones and their possible importance in horticulture.
Sci. Hort., 1937, 5 : 141-52, bibl. 27.

The nature and general properties of growth hormones are discussed briefly, more detailed reference being made to some of the experimental results of promise to horticulture. The mass of evidence which has now accumulated proves beyond reasonable doubt that rooting in cuttings of herbaceous and woody plants that normally strike quite readily can be stimulated or initiated by natural and synthetic auxins applied in pastes or solutions. Horticultural interest, however, is concerned with the inducing of difficult subjects to root, and here success with pastes has been less marked, though there appears more promise in treatments with dilute solutions containing auxins. There are many problems to be solved, and, until the work in progress in Europe and America has made more headway, the author prefers to reserve judgment concerning the possible use to gardeners of the new discoveries.

256. TINCKER, M. A. H. 577.15.04 : 634/5
The relation of growth-substances, or hormones, to horticultural practice : a review.
J. roy. hort. Soc., 1936, 61 : 380-8, bibl. 85.

In this concise outline of research on plant hormones the author traces the progress of our knowledge on the subject from Darwin's discovery of the fact that the response to the stimulus of light occurs not at the point where the light hits but elsewhere to the present day. He notes the work done on the identification and formation of these growth promoting substances by numerous modern workers, particularly Went, and discusses methods of testing them. The following chemical compounds have now been shown to have marked effects on the growth of plants: indoleacetic acid (hetero-auxin), indolepropionic acid, indolebutyric acid, phenylacetic acid, phenylpropionic acid, α -naphthalene acetic acid, acenaphthyl-5-acetic acid, and α -naphthyl acetoneitrile. Moreover, the almost infinite number of substitutions possible in the naphthalene and indole groups suggests that the number of possible substituted fatty acids likely to prove active may be very great. Recently Zimmermann and others have found that several esters act as growth promoting substances [see abst. 265]. To horticulturists one of the most important results achieved is root formation. So far root formation in cuttings has been induced by various workers by applications of the growth substances in the following ways :— application of lanolin containing minute amounts of hormones to the stems, injection of dilute solutions into the stems, addition of substances in solution to soil prior to planting cuttings, and recently, with woody cuttings, placing the cuttings in solutions containing the substances for varying periods prior to transference to the propagating house.

257. COOPER, W. C. 577.15.04 : 631.535
Transport of root-forming hormone in woody cuttings.
Plant Physiol., 1936, 11 : 779-93, bibl. 17.

Evidence is given to show that when hetero-auxin is applied to the apical end of a cutting it, or some substance in the stem activated by it, moves downward in the phloem. As an explanation

of the fact that soaking the basal ends of cuttings in a strong solution of hetero-auxin induces root-formation, it is suggested that this treatment causes the rapid downward movement of a root-forming substance which occurs in the leaves and stem.

H.L.P.

258. TINCKER, M. A. H. 577.15.04 : 631.535
Experiments with growth substances or hormones, and the rooting of cuttings.
J. roy. hort. Soc., 1936, 61 : 510-6.

The article reports some experiments carried out at Wisley in the practical application of recent discoveries in the use of growth promoting substances for hastening the rooting of cuttings. The substances used were β -indolylacetic acid, α -naphthaleneacetic and phenylacetic acid applied at various concentrations in lanolin paste or in solutions. The effects on each of a number of plants are discussed. The paste method proved effective in inducing additional root formation in cuttings of plants normally easy to propagate in this way, but tried on certain plants known to be hard to root from cuttings it was not successful. Such plants were apple—varieties Victory, Melba and Crawley Beauty—*Kalmia latifolia*, *Schima argentea*, *Pittosporum Dalli*, *Hamamelis japonica* and *Rhododendron arboreum*. Treatment with solutions of the substances appears to offer more promise and this method is now being tested with a number of shrubs and trees which have previously proved difficult to propagate. The author makes the following interesting suggestions:—Possibly with some of the difficult species more than one treatment may be essential or the concentration should be higher, or longer intervals may be necessary for absorbing dilute solutions. A further possibility, which is now being explored, is the administration of the growth substances to the plant before taking the cutting from it.

259. GOODWIN, R. H. 577.15.04
The role of auxin in leaf development in *Solidago* species.
Amer. J. Bot., 1937, 24 : 43-51, bibl. 27.

The production of auxin by the seedling leaves of two species of *Solidago* was investigated. In one species, *S. sempervirens*, only one leaf is elongating at a given time. This growing leaf retards the development of the younger leaves, and its removal accelerates the elongating of the next succeeding leaves. The retarding effect is reproduced by applying a paste of hetero-auxin to the cut off petiole of this leaf. In the other species, *S. rugosa*, the leaves are smaller and several normally elongate at once. The maximum production of auxin by the leaves of this species is only half as great as that of the leaves of *S. sempervirens*. It is suggested that the production of auxin in this species is insufficient to cause periodic retardation. Other general conclusions reached are that the total amount of auxin produced by a leaf is very small in the early stages of its development, reaches a maximum at the time of maximum growth, and then falls off again with maturity. The amount of auxin per unit of fresh weight in each species is more or less inversely proportional to the weight of the leaf, indicating that auxin production may reach a maximum in the youngest leaf primordia.

H.L.P.

260. AVERY, G. S. AND OTHERS. 577.15.04
Production and distribution of growth hormone in shoots of *Aesculus* and *Malus*, and its probable role in stimulating cambial activity.
Amer. J. Bot., 1937, 24 : 51-8, bibl. 26.

The production of growth hormone by the shoots of *Aesculus Hippocastanum*, and *Malus Malus* var. McIntosh was investigated by the Avena technique of Went. Growth hormone appears to be entirely absent from the dormant winter buds, but is detectable in increasing amounts during the swelling of the terminal buds of both *Aesculus* and *Malus*. The maximum production of hormone is reached just before the most rapid growth of the current season's

shoots. Growth hormone concentration in fruiting shoots of *Aesculus* is higher than in shoots bearing only leaves. Movement of hormone takes place from the growing shoots downwards into the older portions of the stem. The similarity in the movement of growth hormone and the beginning of cambial activity is noted, and it is suggested that the growth hormone may act as a cambial stimulator.

H.L.P.

261. LAIBACH, F. 577.15.04 : 631.35
 Ueber die Bedeutung der β -Indolylessigsäure für die Stecklingsvermehrung.
 (The importance of β -indoleacetic acid for propagation by cuttings.)
Gartenbauwiss., 1937, 11 : 65-79, bibl. 7.

The author describes here the results of experiments in which he treated soft and hard wood cuttings of some 19 named shrubs or trees belonging to a large number of species with β -indoleacetic acid in paste or liquid form and thereby accelerated and increased root formation. He notes that rooting has also been helped by such treatment in cuttings of plants which do not readily form roots from cuttings, e.g. *Syringa vulgaris* and some of the apple rootstocks, and he proposes in future experiments to test the effect of similar treatment on cuttings of pome and stone fruits, citrus, coffee, tea, etc.

262. HITCHCOCK, A. E. AND ZIMMERMANN, P. W. 577.15.04 : 631.35
 Effect of growth substances on the rooting response of cuttings.
Contr. Boyce Thompson Inst., 1936, 8 : 63-79, bibl. 9.

The indoleacetic and indolebutyric acids were obtained from Ottawa. The naphthaleneacetic acid was made on the spot and the indolepropionic and phenylacetic acids were obtained from a commercial firm. The authors summarize as follows :—"Treating cuttings or shoots of *Ilex*, *Taxus*, *Pachysandra*, *Hibiscus*, *Acer*, and *Chrysanthemum* with preparations of indoleacetic, indolepropionic, indolebutyric, or naphthaleneacetic acids induced earlier rooting, increased the number of roots, and roots emerged from a greater area of stem tissue as compared with control cuttings. Placing the basal ends of cuttings in a tap water solution of the growth substance was particularly effective on *Ilex*, *Taxus*, *Hibiscus*, and *Pachysandra*. This method of treatment is considered as offering much better possibilities for initiating root growth in cuttings than the use of lanolin preparations of the same substances. On a concentration basis, water solutions of the growth substances were from 100 to 500 times more effective than lanolin preparations. Indoleacetic, indolebutyric, and naphthaleneacetic acids were effective over a concentration range of 10 to 20 times when the period of treatment was from 6 to 96 hours. A 24-hour treatment with a solution containing from 4 to 20 mg. of indoleacetic acid per 100 cc. or 2 to 10 mg. of either indolebutyric or naphthaleneacetic acid per 100 cc. was effective for several species. Solutions containing from 1 to 4 mg. per 100 cc. were equally effective when the duration of the treatment was from 2 to 4 days. Lanolin preparations of indoleacetic or indolepropionic acid (30 to 100 mg. per gram of lanolin) were consistently effective on *Acer palmatum* but not on many other woody species which were tested during the spring and summer of 1935. Preparations which were most effective in stimulating root formation also retarded the growth of non-dormant buds."

263. MANSKE, R. H. F. AND LEITCH, L. C. 577.15.04
 The synthesis of δ -(3-indolyl)-valeric acid and the effects of some indol acids on plants.
Canad. J. Res., 1936, 14, Sec. B., pp. 1-5, bibl. 10.

The synthesis of δ -(3-indolyl)-valeric acid, by a procedure analogous to that employed in the synthesis of its lower homologues, is described. It, as well as a bz-methyl derivative of β -(3-indolyl)-propionic acid, which has also been synthesized, was found to possess the plant physiological properties of a phytohormone. [Authors' abstract.] This is a brief account of some of the work of Dr. Manske at the National Research Laboratories, Ottawa, Canada.

264. ZIMMERMAN, P. W. AND HITCHCOCK, A. E. 577.15.04 : 612.014.44

Effect of light and dark on responses of plants to growth substances.

Contr. Boyce Thompson Inst., 1936, 8 : 217-31, bibl. 10.

Several species of plants, e.g. tobacco, tomato, Jerusalem artichoke, potato, African marigold, sunflower, dahlia, were studied under a variety of conditions to determine the effect of environment on their capacity to respond to treatment with various growth substances. Plants in bright light tolerated higher concentrations and made less response than those in deep shade. With low concentrations in light the plants made maximum response in 6-10 hours and then leaves and stems returned to normal, but when similar concentrations were applied to plants transferred to the dark at time of treatment response was more pronounced and the return to normal did not occur. Lanolin preparations containing 1.0% of growth substances induced negative response on plants in the light and positive on those in the dark. However, on retransference to light, negative bending was shown. After 5 days in the dark tomato plants 5 inches high lost their capacity for negative geotropism but not their power of response to growth substances. After a few more days this latter power also disappeared. These phenomena were accompanied by permanent wilting of the leaves, and decrease of carbohydrates and increase of nitrates in the tissues. Older plants resisted longer. The etiolated stems of tuberous plants grown in the dark from the first showed negative geotropism and response to growth substances for 60-80 days after planting. If plants were first grown in the light until 12-18 inches high and then placed in the dark, the response was less marked. Adventitious roots induced in darkness were more feeble than those induced in light.

265. ZIMMERMAN, P. W. AND OTHERS.

577.15.04

Several esters as plant hormones.

Contr. Boyce Thompson Inst., 1936, 8 : 105-12, bibl. 10.

The following plants were used in the tests to which the new growth substances were submitted : tomato, sunflower, Jerusalem artichoke, *Kalanchoe Daigremontiana* and *Cissus sicyoides* L. var. *Jacquinii* Planchon. The authors note that the esters of the indole compounds are more effective for accelerating local growth of green plants than their corresponding acids, an important fact seeing that the esters are intermediary products in Manske's method of manufacturing the indole acids. They summarize as follows :—"Nine esters have been added to the list of growth substances as follows :—methyl α -naphthaleneacetate, ethyl α -naphthaleneacetate, methyl phenylacetate, ethyl phenylacetate, η -butyl phenylacetate, iso-butyl phenylacetate, methyl β -indoleacetate, methyl β -indolepropionate, methyl β -indolebutyrate. Methyl esters of these compounds were shown to induce adventitious roots on stems, leaves, and roots and to cause local acceleration of growth and other responses characteristic of growth substances. One of the esters, methyl β -indoleacetate is more effective than hetero-auxin (β -indoleacetic acid). The methyl esters of the indole compounds were more effective for inducing bending responses than their corresponding acids. The methyl esters of the naphthalene and phenyl compounds were slightly less effective than the corresponding acids. The methyl esters were more effective than the ethyl and the latter more effective than butyl esters. The esters were taken up by the roots from water solutions added to the soil and transported upward as evidenced by formative responses of aerial parts of the plants."

266. BROWN, N. A. AND GARDNER, F. E.

577.15.04

Galls produced by plant hormones, including a hormone extracted from *Bacterium tumefaciens*.

Phytopathology, 1936, 26 : 708-13.

20 milligrams of indoleacetic acid in 1 gram of lanolin and a similar mixture of indolepropionic acid resulted in the production of galls when smeared on wounded stems of bean, tobacco, sunflower, Paris daisy, privet and *Impatiens Balsamina*. A *Bryophyllum* and a *Kalanchoe* responded by forming a few roots, while *Ricinus* produced neither galls nor roots. A growth promoting substance, extracted with peroxide-free ethyl ether from *Bacterium tumefaciens* growing in a synthetic medium containing 2% dextrose, 1% peptone, the usual inorganic

salts and a little tryptophane, when applied in lanolin to bean seedlings and daisy stems, produced galls which grew at about the same rate as those produced by indoleacetic acid. The chemical nature of this hormone produced from *Bacterium tumefaciens* has not yet been determined.

267. KEMP, E. E. 631.535 : 631.415
On acidie rooting-media for cuttings.
Gdnrs' Chron., 1936, 99 : 27-8, bibl. 9.

Literature on the watering of rooting-media with dilute acid solutions is briefly discussed with particular reference to several experiments carried out at Edinburgh. The theory, that cuttings of different species will root most readily in media which possess pH values similar to those found in soils with which the species are commonly associated, is, in the author's opinion, entirely unsupported by the available evidence.

268. KRAMER, P. J. 612.014.44
Effect of variation in length of day on growth and dormancy of trees.
Plant Physiol., 1936, 11 : 127-35, bibl. 25.

The behaviour of potted seedlings—from seed to 2 years old—of some 10 species of North American trees was observed under various lengths of day. Results indicate that variations in length of day may, to a considerable extent, control the duration of the growing season of certain tree species. They strongly support the view that dormancy is not caused by any inherent rhythm in plants, but is produced by the action of various environmental factors on the complex of internal physico-chemical phenomena which control growth.

269. STAMPA, G. 612.014.44 + 631.544
The action of radiant heat and light rays on the life of plants. Heating and forcing plants in the open air.
Int. Rev. Agric. (Mon. Bull. agric. Sci. Pract.), 1936, 27 : T.321-T.329 and T.361-T.371, bibl. 11.

The author discusses the effects of heat and of light on plant life and notes how experiments in Holland, Denmark, Sweden and England have shown that for optimum life and fruit production a plant must attain its maximum degree of chlorophyll assimilation. For this there should be a *determined relation between the luminosity of the atmosphere and the temperature*, and for each intensity of light there exists *one and only one temperature*,* in which the building up of plant material in any given plant attains its maximum. After a consideration of different sources of illumination both natural and artificial and methods used to intensify the illumination available, the author notes the importance of humidity in soil and air during forcing operations and the various devices made to preserve it. Lastly he discusses at some length the Bigeault system of soil heating by means of heat radiating walls or panels. [See *H.A.*, 1937, 7 : 4 and 5.] He comments on the Bigeault system as follows:—The plant receives the infra-red rays emitted by concrete panels containing serpentine hot water tubes, the temperature of which does not exceed 40° C. The calorific radiations traverse the air without heating it. These radiations are absorbed by the plants. . . . This phenomenon may be compared to that produced by solar rays which, without noticeably heating the air traverse it and strike the soil or a wall and heat it in proportion to their strength. . . . In consequence of the even temperature maintained at all points eddies in the air are not observable. The dark calorific rays emitted by walls at low temperatures may, therefore, solve the general problem of heating, and the method has the following advantages:—(1) Complete absence of eddies in the air. . . . (2) No dust—no overheating. (3) Maintenance of humidity of air which is not overheated or dried up. (4) Ventilation possible without noticeable loss of heat and without appreciable reduction in room temperature. (5) Economy in fuel. Illustrations are given of a complete installation at the Établissement Moreux Frères, Noisy-le-Roi, Seine-et-Oise, France.

* Author's italics.

270. STOUGHTON, R. H. 581.143.26

A review of the problem of bud dormancy.

Sci. Hort., 1937, 5 : 115-23, bibl. 23.

After a brief explanation of the nature of the different kinds of dormancy the paper concentrates mainly on methods of breaking the rest period with a view to the production of earlier crops. Factors associated with the breaking of dormancy are temperature, moisture and desiccation, light and chemical treatment. Each method is separately discussed. The physiological changes associated with the breaking of dormancy, the causes of dormancy, and the mechanism of dormancy breaking are also explained.

271. BELL, H. P. AND FACEY, V. 581.145.1 : 578.08

Microtechnique for winter buds.

Canad. J. Res., 1937, 15, Sec. C., pp. 129-34.

The technique is described of preparing unbroken series of sections of winter flower-bud material for microscopic examination. Owing to the diverse but characteristic structures found within the bud this cannot be done by the ordinary methods of dehydrating, imbedding, etc.

272. HIRT, R. R. 551.57.018

A simple device for recording the time and duration of rainfall.

Phytopathology, 1936, 26 : 1,064-7.

A simple inexpensive instrument is described, by means of which the time and duration of rainfall may be recorded automatically in an experimental area. One such instrument has been in use in New York State for two years in connexion with epidemiological studies, and is still in good working condition.

273. ZINK, F. J. AND GRANDFIELD, C. O. 581.084.1

Humidity control in large chambers by means of sulphuric acid solutions.

J. Amer. Soc. Agron., 1936, 28 : 463-6, bibl. 5.

It was found possible to obtain any desired relative humidity in two cabinets, one containing 9 cubic feet of air space and the other 56 cubic feet by exposing sulphuric acid in open trays in the chambers. A small fan prevented the formation of a scum on the surface. The authors discuss the amounts of acid and the specific gravity necessary under different circumstances and the influence of temperature on results.

274. YNALVEZ, L. A. 545.71

A simple self-adjusting burette.

Philipp. J. Agric., 1937, 25 : 865-6.

An automatic self-adjusting burette is described which can be made from ordinary laboratory apparatus. Air pressure is supplied from a suction pump which can go on continuously without bursting the apparatus and so eliminates the inconvenient hand-pump. A diagram of the assembly is supplied, showing clearly the details of construction and arrangement.

275. WITHROW, R. B. AND BIEBEL, J. P. 631.8 : 631.67

A subirrigation method of supplying nutrient solutions to plants growing under commercial and experimental conditions.

J. agric. Res., 1936, 53 : 693-701, bibl. 7.

The system of supplying nutrient solutions to plants, which is described here with the aid of a diagram, was designed to combine the advantages of a uniform supply of nutrients and aeration given by the "drip-culture" technique with the relative simplicity of the so-called "slop-culture" method, whereby nutrient solutions are poured on to the surface of the sand at intervals, without the attendant waste of nutrients of either of these systems. The sub-irrigation method consists in principle of pumping nutrients from a submerged reservoir into the bottom of a shallow bed of fine gravel or cinders with a centrifugal pump. The pump is controlled by an electric time switch which stops the operation when the bench is flooded, the

solution then flowing back by gravity through the pump into the tank. The method is suitable for large-scale production, but modifications are described whereby it may be adapted to small-scale experiments. The advantages claimed for the system are (1) frequent and complete flushing of the roots with air and nutrient solution, (2) economy of nutrients since the solution drains back into the tank again, and (3) completely automatic operation over long periods of time.

276. KRAMER, P. J. 581.11
The relation between rate of transpiration and rate of absorption of water in plants.

Amer. J. Bot., 1937, 24 : 10-5, bibl. 20.

Livingston auto-irrigator cones were used to determine simultaneously rates of absorption and transpiration in green ash (*Fraxinus pennsylvanicum* var. *lanceolata*), yellow poplar (*Liriodendron Tulipifera*), loblolly pine (*Pinus Taeda*), cactus (*Opuntia* sp.) and sunflower plants (*Helianthus annuus*) growing in soil, and in sunflower plants and rooted willow cuttings (*Salix nigra*) growing in nutrient solutions. In all species except *Opuntia* transpiration exceeded absorption during the day, reaching a maximum near mid-day, and absorption exceeded transpiration during the night. *Opuntia* had its maximum rate of transpiration from 6 to 10 p.m. The plants grown in nutrient solutions behaved in a similar manner to the plants grown in soil, although in certain instances, where the leaf area was small in proportion to the root system, transpiration did not appreciably exceed absorption during the day. Absorption lagged behind transpiration to about the same extent in all species, indicating that there is no characteristic difference between woody, herbaceous and succulent plants in this respect. In sunflower plants it was found that the time of minimum leaf moisture content coincided approximately with the time of maximum transpiration, but that the time of maximum leaf moisture content was in the middle of the night, several hours before the rate of transpiration began to increase. The fact that changes in rate of transpiration precede changes in rate of absorption is held to indicate that, under ordinary growing conditions, the rate of water intake is probably largely determined by the rate of water loss. The lag of absorption behind transpiration is thought to be due to the fact that the rate of transpiration responds immediately to changes in environmental conditions, whereas absorption does not increase until the effect of the saturation deficit caused in the leaves by transpiration is transmitted to the roots. Thus, although at night the closing of the stomata checks transpiration abruptly, the saturation deficit is not immediately satisfied and absorption decreases more slowly than transpiration.

277. SCHNEIDERS, E. 576.31 : 632.1/8
Über die Zellstäbe und ihre phytopathologische Bedeutung. (Cell rods (or bars) and their phytopathological significance.)

Gartenbauwiss., 1937, 11 : 237-50, bibl. 25.

The presence of cell rods has hitherto only been connected in a causative capacity with disease in the "Reisig" disease of vines. The question is here discussed whether all plants which contain cell rods can really be considered as diseased. Three instances are noted in blackberries, cherries and potatoes in which a direct connexion has been established between the occurrence and frequency of cell rods and pathological deterioration in those plants. In potatoes, whereas cell rods were found in the tissues of virus infected plants, very few or none were found in those of apparently healthy plants.

278. VANSELOW, A. P. AND LAURENCE, B. M. 546.47 : 544.6
Spectrographic microdetermination of zinc.

Industr. Engng Chem., Anal. Ed., 1936, 8 : 240-2, bibl. 4.

A quantitative, spectrographic method for the determination of zinc in plant material has been studied and presented. [The method has been used in determining the zinc content of citrus leaves and a few typical results of these analyses are tabulated.—ED.] The range of the method

is from about 1 to 100 p.p.m., or more, depending on the size of the sample used. Cadmium is used as the internal standard, the zinc and cadmium being co-precipitated as the sulphides before arcing. No other elements are present in the sulphide precipitate in amounts sufficient to cause interference. The maximum deviation from the mean of duplicate analysis is about one part in five. [Authors' summary.]

279. GRAINGER, J. AND ARMSTRONG, T. F. 631.588.1 : 631.544
Some practices of electric heating of the soil and air.
Gdnrs' Chron., 1936, 99 : 389 and 407-8.

Experiments with electric soil heating cables in wooden frames at Huddersfield have shown these to be satisfactory for forcing mint and for raising seedlings of lettuces and endive until ready for pricking out. Attempts to force lettuce and endive after this stage and also carrots, turnips and radishes resulted in flower formation.

TREE FRUITS, DECIDUOUS.

Breeding.

280. CUMMINGS, M. B. AND OTHERS. 634.13-1.522
Sterility in pears.
Bull. Vt agric. Exp. Sta., 408, 1936, pp. 83, bibl. 37.

The causes of sterility in pears with special reference to Bartlett and its allied group have been studied. Studies have been mainly concentrated on pollen germination and pollen tube growth both in artificial media and in styles of self- and cross-pollinated flowers. Sterility is not a constant condition but varies somewhat with season and location. Bartlett when used as a pollinator for other self-sterile varieties gives a high percentage set, thus proving that its pollen is not defective. Its pollen grains give a high percentage of germination in artificial sucrose-agar media showing that they are viable. In self pollinations the rate of pollen tube growth is very slow and tubes do not reach the ovary before the flower decays. On the other hand in compatible cross pollinations tubes grow with accelerated growth. Cessation of tube growth in incompatible pollinations is not due to particular inhibitory substances but may be due to the stimulating agents which promote growth being rendered non-effective or less effective, while in a compatible cross these substances are secreted freely. The most favourable period for pollination is from one or two days before and up to full anthesis which indicates that the stigma is receptive two to three days before anthesis. The number of good seeds usually secured from self-pollinated varieties is very small, but cross-pollinated varieties produce more.

D.N.S.

281. FLEMION, F. 634.25-1.531
A rapid method for determining the germinative power of peach seeds.
Contr. Boyce Thompson Inst., 1936, 8 : 289-93, bibl. 4.

Experiments with seeds of several peach varieties have shown that, if both the pericarp and the inner seed coat are removed and the naked embryos mixed with moist granulated peat moss at room temperature, a test of the germination capacity of dormant peach seeds can be obtained in ten days. The percentage germination procured in this way agrees well with that obtained when the seeds are after-ripened at 5° to 10° C. for several months. Reference is made to a recent paper by Tukey and Barrett (see abst. 282), in which a method of testing the germination capacity of peach seeds is described involving the use of an agar medium with nutrient materials on which the naked embryos are placed. The present experiment shows that neither the agar nor the nutrient materials are necessary, and that tests can be carried out readily under commercial conditions without any special equipment.

282. TUKEY, H. B. AND BARRETT, M. S. 634.25-1.531
Approximate germination test for non-after-ripened peach seed.
Plant Physiol., 1936, 11 : 629-33, bibl. 5.

Peach seeds from 7 sources were cracked, the seeds soaked for several hours in water and the seed coats removed together with any small amount of nucellar tissue and endosperm. Naked embryos were sterilized in 2% chlorine solution for 30 minutes and then placed in sterilized $\frac{1}{2}$ oz. bottles on 2-3% agar medium. The germination results in 7 days were compared with those obtained from exactly similar seed after-ripened 10-15 weeks at 5° C., and were found to agree with them. Again a comparison of germination of seed from 3 sources grown in culture solution as above and of seed autumn planted in commercial fashion showed a marked agreement. A room temperature of 18°-22° C. was found to be satisfactory. Various nutrients and agar concentrations other than 2-3% failed to improve the response or else proved to be inhibiting.

*Propagation and rootstocks.**

283. PASSECKER, F. 631.535 : 634.11 + 635.1/7
 Versuche über die ungeschlechtliche Vermehrung von Obst und Gemüse.
(Vegetative propagation of fruit and vegetables.)
Gartenbauwiss., 1937, 11 : 80-4, bibl. 3.

By passing a wire fairly tightly round the stems of apple seedlings, mainly American dessert varieties, about 5-8 cm. above ground level, and heaping the soil over the place, the author induced excellent rooting 8 weeks from the start of the operation, i.e. from 16 August. He also had success in rooting cuttings of tomatoes, beans and *Vigna sinensis* by ordinary methods.

284. UPSTALL, W. H. 634.25 : 581.144/5
Types of peach buds in relation to nursery practice.
Sci. Agric., 1937, 17 : 445-6.

Usually 1-3 buds are to be found in the leaf axils of the peach. It is essential for success in budding that one bud should be a leaf bud or no growth will result. When single buds are to be used (some varieties have many of these) the large plump buds should be avoided. The idea of nurserymen that multiple buds used for budding tend to depress growth is shown to be fallacious. A distinct gain in stand of buds was achieved as a result of using double or triple buds in preference to singles.

285. SHAMEL, A. D. AND POMEROY, C. S. 575.252 : 634.1/8
Bud mutations in horticultural crops.
J. Hered., 1936, 27 : 487-94, bibl. 68.

The authors summarize the very extensive information published since 1741 on the subject of bud mutation in fruit crops, particular attention being paid to recent work on deciduous top fruits. Some 863 bud mutations recorded prior to 1936 in apple, pear, peach, plum, cherry, and grape are tabulated and analysed as to type of mutation whether in fruit or in other parts of the tree and as to type of mutation in those particular parts. Thus mutations show more or less colour in their fruits, larger or smaller fruits, earlier or later maturing fruits, etc. As might be expected, owing to the ease of observation, nearly half the mutations noted vary in colour of fruit. Citrus mutations, 1,664 in number, are similarly summarized, particularly so far as concerns Washington Navel and Valencia orange. The table dealing with small fruits contains only 234 mutations, but includes examples from most of the ordinary small fruits of temperate zones. Further it is noted how large a part bud mutation has played in the evolution of cultivated flower varieties of all sorts. It is suggested that the use of X-rays and other methods for stimulating somatic variations may lead to a rapid increase in the number

* See also 254-67, 289, 336, 421, 523.

of commercial varieties originating in bud sports. Notes are given on the best method of searching for bud mutations in the field, on progeny tests and on commercial tests. The article, especially in its reprint form with 185 references [only 68 included in *J. Hered.*—ED.], should be of great reference value.

286. DE WET, A. F. 634.1/2-1.533/534
Fruit-tree rootstocks. Propagation by means of stoolbeds.
Fmg S. Afr., 1937, 12: 69-70.

The propagation of deciduous fruit-tree rootstocks by means of stoolbeds under dry conditions is described. At present only one commercial nursery in the Union of South Africa is testing this method of raising stocks, but the author considers that, in the case of varieties which lend themselves to the practice, this form of layering is the most desirable method of propagation with the possible exception of hardwood cuttings. Preliminary trials with apples in the Stellenbosch-Elzenburg College nurseries have given very encouraging results, and more extensive trials with apples, pears and plums have been started.

287. DE WET, A. F. AND MICKLEM, T. 631.541.44: 634.1/2
Top-working old fruit trees.
Fmg S. Afr., 1936, 11: 237-8.

The method of top-working described here is "stub-grafting" which has given the most promising results of all the methods tested at Stellenbosch on apple, pear and plum trees.

288. FOWLER, R. 634.8-1.541.44
Reworking fruit trees. Part I.
 LEISHMAN, E.
Part II.
 ORCHARD, H. H.
Part III. Budding.
J. Dep. Agric. S. Aust., 1936, 39: 1,460-73; 1936, 40: 124-8 and 436-9.

The first author describes the various methods of top grafting hitherto commonly practised, and mentions certain of their disadvantages which have led to the introduction of new methods. The methods he describes are cleft grafting, bark or crown grafting, and strap grafting, and a section is also devoted to grafting wax. The second author describes the peg, plug, porcupine or chisel graft and the oblique cleft graft, both of which are methods in which the original framework of the tree is retained. The third author describes framework budding. Each of the articles includes a number of diagrams and photographs.

Rootgrowth.

289. ROEMER, T. AND HILKENBÄUMER, F. 581.144.2: 634.11+634.13
 Wurzelstudien an 25-jährigen Kernobstbäumen.* (**Root studies on 25-year-old pome fruit trees.**)
Kühn-Arch., 1936, 42: 281-303, bibl. 12.

The root systems of 130 apple trees of 4 varieties all on Jaune de Metz rootstock, and 130 pear trees, of 6 varieties on Angers quince rootstock, were studied by careful digging up after 25 years in the orchard. Data concerning general root conformation and distinctive varietal effects are given. The stocks are described as not clonal, but a fairly uniform selection. The authors found that the roots spread two to three times as far as the branches, and that there was much root interlacing. Fibrous root was distributed over the whole root area. In the apples the shallowest roots were at 20 cm. below the soil surface, and the bulk of the roots was 30 to 50 cm. deep. In the pears the shallowest roots were 10 cm. deep, and the bulk was

* Translation available.

25 to 40 cm. deep. The deepest root noted was 63 cm. No tap roots were found. The roots did not penetrate the clay substratum. [Full details of the soil are not given, and the authors fail to note that very different root conformation is found on some loams and sands. See *J. Pomol.*, 11: 1-18 and 12: 110-50; *H.A.*, 1933, 3: 154 and 1934, 4: 329—Abstractor.] With regard to scion influence on rootstock, the authors found that the amount of "fibre" produced by the rootstock varied with different scion varieties. This was not only a question of vigour, for Belle de Boskoop on Jaune de Metz produced little fibre, while Transparent on Jaune de Metz though similar in vigour, produced much fibre. Biesterfelder Renette behaved in this respect like Boskoop, while Peasgoods Renette had a medium amount of fibre. Another difference noted was in the angle between the main roots and the trunk. The roots of Boskoop made an angle of 83°, while Peasgoods Renette roots made an angle of only 71° with the trunk. The authors state that the character of the rootstock roots, both as regards fibre and root angle, closely resembled that of scion roots of the scion variety. Many of the trees were scion rooted. [A separate paper was published on this aspect in *Gartenbauwiss.*, 10: 610; *H.A.*, 1937 1: 27.—Ed.] Of the pears, Vicar of Winkfield and Edelcrassane, which were respectively the most and least vigorous of the varieties examined, both produced little fibre. Bergamotte d'Esperens, a weak grower, had much fibrous root, and Louise Bonne was similar. Alexander Lucas and Duchesse d'Angoulême were intermediate. These results which apparently depend on visual judgment are illustrated by numerous photographs. The authors conclude that the scion "has a definite influence on the growth, structure and form of the roots" and even suggest that "a naturally variable rootstock can by working with particular varieties be forced into great uniformity", yet they say, "it is undoubtedly the stock which is the dominating partner. The influence of scion on stock is always considerably less than the influence of stock on scion." The review given of other work on the reciprocal influence of stock and scion is misleading, since it takes no account of important work in England later than 1930. [See *J. Pomol.*, 10: 219-27, 11: 1-18, and 13: 293-350; abstracted *H.A.*, 1933, 3: 13, 3: 154 and 1936, 6: 13; also *Annu. Rep. East. Malling Res. Sta. for 1934*, A18, 1935, pp. 87-9 and 90-9, abstracted *H.A.*, 1935, 5: 175 and 174.—Ed.]

W.S.R.

Pollination.

290. JOLEY, L.

634.11 : 581.163.2

Notes on pollination of Northern Spy.

Quart. Bull. Mich. agric. Exp. Sta., 1936, 18: 240-2.

It is noted that Northwestern Greening, Mother, Williams and Tolman Sweet blossom comparatively late and hence overlap the blossoming period of Northern Spy. The two latter varieties are known to pollinate Spy well. The propensities of Northwestern Greening and Mother pollen were studied at East Lansing in 1935. Both were found to furnish pollen which produced a good set of Spy fruit, although the sets obtained were slightly lower than those produced by pollen of another variety, Steele Red, or by open pollination. In the course of extracting the pollen, however, it was observed that the amount of pollen produced by Northwestern was relatively small, while field observations have also indicated that this variety is not very satisfactory as a pollinator for Spy. Phenological data obtained in 1935 for Jonathan, McIntosh, Mother, Northwestern, Tolman and Spy are included.

291. NEBEL, B. R.

575.18 : 634.11

Metaxenia in apples.

J. Hered., 1936, 27: 345-9, bibl. 15.

The author discusses briefly the general conclusions which can be drawn from his own and other experiments with apples. Experiments have proved that two apples on the same tree with the same number of seeds and the same conditions of environment, but originating from different kinds of pollen, may show slight physiological differences leading to small but consistent differences in acidity, size, keeping quality, general variability, pH and sugar content.

292. KREMER, J. C. 634.23 : 581.145.2
Observations on fruit setting in the cherry in 1936.
Quart. Bull. Mich. agric. Exp. Sta., 1936, 19 : 94-6.

The poor set of Montmorency cherries in Michigan in 1936 is attributed to abnormally high temperatures in southern parts of the State and to cool windy weather in northern parts during the blossoming period. Both these conditions prevent nectar secretion and reduce the activity of honey bees. It has been shown that, provided other factors are favourable, nectar secretion occurs in fruit blossoms in Michigan when the temperature lies between 65° and 75° F., but seldom at temperatures outside this range. The presence of strong colonies of bees in the neighbourhood of a few orchards resulted, however, in fairly good crops of cherries, and it is considered that this was due to the fact that the large numbers of bees present could transfer sufficient pollen during the relatively short periods when nectar was being secreted by the blossoms. In normal seasons a much smaller number of bees would probably be adequate, since they would be transferring pollen over longer periods.

Growth, Nutrition.

293. MARTIN, W. E. 634.13 : 581.192
Distribution of certain sugars in Bosc pears.
Plant Physiol., 1936, 11 : 139-47, bibl. 14.

The material was Bosc pears from a single tree. The pears were picked on 26 August, 1934, and removed from store for analysis on 20 January, 1935. The methods of sampling and experimental technique are fully detailed. Each pear was divided for chemical analysis into a skin region, a cortical region, a stone cell region and a core region. Fifty-four per cent. of the fresh weight was found in the cortical region, 28% in the stone cell, 11% in the skin and 7% in the core region. Particularly significant differences were noted in the concentrations of the individual sugars in the different regions. Thus levulose was predominant in all parts except the skin, the highest concentrations being in the cortical and core regions. Sucrose was in largest amounts in the stone cell region and in lessening amounts in the cortical, core and skin regions. Dextrose was present in largest amounts in the skin, while the amounts in other regions differed only slightly. Results indicate that in taking samples of Bosc pears for chemical analysis the amounts of material from each of the 4 regions of the fruits should be present in proportion to the total amounts of tissue of each of those regions actually present in the fruit.

294. HULME, A. C. 634.11 : 581.192
Biochemical studies in the nitrogen metabolism of the apple fruit. II. The course followed by certain nitrogen fractions during the development of the fruit on the tree.
Biochem. J., 1936, 30 : 258-68, bibl. 23.

The author gives full details of the analytical methods used by him in determining the total nitrogen present at different stages of the apple fruit's growth on the tree and its differentiation into total soluble nitrogen, free ammonia- and amide-nitrogen, amino-nitrogen- and—by subtraction, etc.—amino-acid-nitrogen, "rest" nitrogen and "protein" nitrogen, and in determining also the titratable acid. Results of analysis of peel and pulp from petal fall to maturity are graphed. They indicate that there are three stages in the nitrogen cycle of the developing apple fruit. It is noted that results obtained for free ammonia and amino-acid-nitrogen and titratable acid provide evidence which appears to be inconsistent with the hypothesis of Ruhland and Wetzel that acid formation in plants is intimately connected with their nitrogen metabolism.

295. HULME, A. C. AND ROACH, W. A. 634.11 : 581.192 : 581.111
Biochemical studies in the nitrogen metabolism of the apple fruit. III. Preliminary experiments on the effect of injecting nitrogenous compounds into apple trees on the composition of the fruit.
Biochem. J., 1936, 30 : 1,397-1,404, bibl. 15.

The material used in this experiment consisted of 6 bush trees of King Edward VII budded on Type IX rootstock and 4 trees of Bascombe Mystery on Type V planted as maidens in

December, 1921. In the extraction of the soluble nitrogen an improved form of continuous vacuum extractor was used. A full description supported by a diagram to scale is given of the apparatus. The authors summarize as follows :—“ 1. Two varieties of apple trees were injected in the summer of 1935 with solutions of ammonium nitrate, urea, and asparagine. 2. The fruit, gathered in the autumn, from the injected trees contained greater amounts of total nitrogen than from the uninjected trees ; the distribution within the total nitrogen was also different. 3. When detached from the tree and placed at 9·5°, fruit from trees injected with ammonium nitrate and with asparagine did not synthesize protein, whereas that from untreated trees synthesized considerable amounts of protein. 4. Further experiments are necessary to determine whether this difference in behaviour is a direct result of the injection or whether it is due to delayed ripening of the fruits from the injected trees.”

296. NIEMANN, C. AND OTHERS. 634.11 : 581.192

The isolation and characterization of a starch polysaccharide from the leaf tissue of the apple tree (*Malus Malus*).

J. biol. Chem., 1936, 116 : 447-55, bibl. 13.

The technique used in isolating a starch polysaccharide from the leaf tissue of an apple tree (variety not stated) is fully described. It was found to be a polyglucosan similar in structure to the β -amylose of cereal and tuber starches and to the starch polysaccharide previously isolated from the woody tissue of the apple tree. [From authors' summary.]

297. SANDO, C. E. 634.11 : 581.175.11

Colouring matters of Grimes Golden, Jonathan and Stayman Winesap apples.

J. biol. Chem., 1936, 117 : 45-56, bibl. 12.

The flavonol glucoside occurring in the skins of Grimes Golden and Jonathan apples and the anthocyanin colouring matter present in Jonathan and Stayman Winesap apples are here identified as 3-galactosidylquercetin and 3- β -galactosidylcyanidin respectively. [From author's summary.]

298. STOBBE, P. C. 634.11-1.4

Adaptation of apple orchards in Quebec to special soil types.

Sci. Agric., 1937, 17 : 329-32.

A description and classification is given of various soils of Quebec and their suitability for apple cultivation is discussed.

Manuring, Cultural practice.

299. ASKEW, H. O. 631.811.9

Plant nutrition. Role of minor elements in plant health.

Orchard. N.Z., 1936, 9 : 303-5.

The author gives a brief account of investigations, carried out in many parts of the world, which have shown that traces of boron, copper, manganese and zinc are essential to the healthy growth of cultivated plants, and he considers the name “micrometabolism”, suggested by one investigator, to be an apt term to describe the functions of these and other minor elements which are present in very small quantities in plant material. Various disorders found to be associated with deficiencies of the four elements noted above are mentioned, but unfortunately there is no bibliography by means of which reference to the original investigations may be made.

300. THOMAS, W. 634.11-1.83

The distribution and condition of the potassium in a differentially fertilized Hagerstown clay loam soil planted to apple trees in cylinders.

J. agric. Res., 1936, 53 : 533-46, bibl. 23.

It was shown in an earlier paper (*Ibidem*, 1933, 47 : 565-81 ; *H.A.*, 1934, 4 : 37) that when sodium nitrate, monocalcium phosphate and potassium sulphate were applied in the proportions

3 : 8 : 4 to apple trees grown in Hagerstown clay loam soil in metal cylinders for a period of $6\frac{1}{2}$ years, the trees giving optimum growth and production absorbed N, P_2O_5 and K_2O in the ratio 3.0 : 0.3 : 1.5. Because of the great divergence in these ratios, studies were made to determine the distribution and condition of the N, P_2O_5 and K_2O in the soil at the end of the experiments. The results relating to nitrogen have been reported *Ibidem*, 1934, 48 : 845-55 (H.A., 1934, 4 : 348), and those relating to phosphorus *Ibidem*, 1935, 51 : 321-39. The present paper reports an investigation of the status of the K_2O in the three soil horizons in the cylinders, namely, 0-7 inches, 7-21 inches and 21-53 inches, following removal of the trees which had received different combinations of N, P and K for the $6\frac{1}{2}$ year-period. It was found that approximately one-third of the residual applied potassium had moved into the sub-surface horizon (7-21 inches), but there was no definite evidence to show that any had moved into the 21-53-inch layer. In order to discover the condition of the potassium, determinations were made of the amounts of K_2O removed by continuous leaching with three solvents, namely, (1) freshly boiled distilled water, (2) M/2 ammonium acetate, and (3) 0.2 N nitric acid. The amounts of K_2O removed from the surface soils (0-21 inches) of both the check and treated cylinders by distilled water was more than half of that removed by M/2 ammonium acetate. The latter represents the so-called exchangeable K_2O , and the author discusses the necessity for reconsideration of the significance of data on this and all water-soluble K_2O in soil investigations. A system of green manuring used in the first 2 years after the trees were planted was found to have increased the so-called exchangeable K_2O of the 0-21 inch layer by almost 50% compared with the original soil (i.e. before the trees were planted). The relative quantities of the residual applied K_2O removed under conditions of continuous percolation from the 0-21 inch layer of NPK cylinders with a sod cover crop were approximately 40% by distilled water, 50% by M/2 ammonium acetate and 81% by 0.2 N nitric acid. It has been possible from the present and previous experiments to work out a theoretical fertilizer ratio for apple trees in a Hagerstown clay loam soil. This is given as N, 4.47 : P_2O_5 , 8.0 : K_2O , 3.28, which is comparable to the complete fertilizer combination, 3 : 8 : 4, used in this experiment and mentioned above.

301. WARNE, L. G. G.

634.11-1.83

Observations on the effect of potash supply on the water relations of apple trees.

J. Pomol., 1937, 15 : 49-55, bibl. 6.

Experiments were carried out on apple shoots from 2 sources :—(1) Lane's Prince Albert trees on Malling II rootstock planted as maidens in December, 1926 at Long Ashton and since then under arable cultivation, (2) Bramley's Seedling trees on Crab rootstock planted as 3-year-olds in the winter of 1919-20 at Goostrey, Cheshire, and also under arable cultivation. The manurial treatment since planting in the former case and for the last six years in the latter is known and stated. The method used was to take comparable leader shoots in July and August from 2 sets of trees, cutting at the base of the previous year's growth. Only shoots not under the direct influence of fruit were used. The shoots were subjected to various measurements and their conductivity was determined by a simple apparatus which is here illustrated, the operation being detailed. Results, which are tabulated, indicate that the effect of potash deficiency is significantly to decrease shoot length, number of leaves per shoot, area of foliage carried by shoot, ability of shoot to transmit water and the ratio conductivity/leaf area, to decrease, probably significantly, the ratio conductivity/number of stomata, and to increase significantly stomatal frequency. The author suggests that the reduction in the ratios conductivity/leaf area and conductivity/number of stomata is one of the reasons why potash deficient trees are particularly susceptible to drought.

302. AUBIN, L.

634.25-1.542

La taille du p  cher. (The pruning of peaches.)

Bull. Soc. nat. Hort. Fr., 1936, 3 : 126-8.

This French method of pruning peaches may be of interest to peach growers elsewhere. The gist of the advice given is as follows : In whatever form of tree peaches may be grown, annual

pruning is an essential operation. The best time to prune is just before the flowers open. In peaches five types of shoot have to be recognized and treated in different ways. These are as follows: (1) Spurs (*bouquet de mai*), 2-4 cm. long, bearing at the apex 4 or 5 flower buds with a wood bud in the centre. These are very fertile and should not be pruned. (2) Small, thin shoots of variable length (*branche chiffonne*) on which all the buds except the terminal are fruit buds. These shoots should also be left unpruned, unless, as sometimes happens, a wood bud develops at the base when the shoot should be cut back to this point. (3) Mixed shoots of medium vigour, bearing both wood and fruit buds are valuable for producing both fruit and new fruiting wood and should be cut back to a third of their length or better to 5 or 6 pairs of flower buds. (4) Vegetative shoots devoid of fruit buds are uncommon on good peach varieties, but if they appear should be cut back to leave only 2 or 3 basal buds in the hope that these will form mixed shoots the following season. (5) Water shoots, if required for the framework of the tree, should be weakened by making an incision at the base, covering the wound with a little tar or grafting wax, but, if not required for this purpose, they should be removed.

303. PASCUAL, A.

634.63-1.542

New systems of olive pruning.

Int. Rev. Agric. (Mon. Bull. agric. Sci. Pract.), 1936, 27, T.256-T.261, bibl. 3.

The author discusses the progress that has been made in the last ten years in the more rational pruning of olive trees founded on the trials of Tonini and Roventini in Tuscany and Umbria respectively. Briefly the two systems are based on the need for distributing the sap between the wood and the fruits while increasing the capacity of the olive to accumulate large reserves. In the "Tonini" system the tree is so pruned as to have 5-6 main branches, which should be allowed to elongate with an approximately equal number of side shoots on each side. Annual pruning ensures that the equilibrium so formed is preserved. The result is a vase shaped tree, the outside of the vase being formed by the branches, each of which by its pruning becomes pyramidal in shape. The new method has resulted in very greatly increased crops and figures of trials in commercial groves at Rosignano with the Roventini and at Montepetriolo with the Tonini systems show that production has been more than doubled in a few years, while oil yield per tree rose from 0.67 kg. in 1930 to 1.34 kg. in 1931, to 1.38 kg. in 1932, to 1.83 kg. in 1933, and to 3.03 kg. in 1934 in the first case, the figures of oil production not being available for Montepetriolo.

SMALL FRUITS, VINES, NUTS.

304. WHELAN, J. W.

634.725

The Chinese gooseberry.

N.Z. J. Agric., 1937, 54: 105-8.

The Chinese gooseberry (*Actinidia chinensis*) is a deciduous, dioecious, climbing, woody plant of vigorous growth bearing brown-skinned, green-fleshed fruits with a flavour of ripe gooseberries. A rich, loamy, well-drained soil is preferable with a good water supply, especially during the fruiting season. A model plantation at Wanganui, N.Z. consists of 60 vine stools set 9 ft. apart each way in the proportion of 1 male to 6 females. Each vine is supported on a pole 8 ft. high from ground level connected to its neighbour at the top and anchored, at the end of each row, by a strand of No. 8 fencing wire. The vines are trained up the pole and along the wire. This plantation produced 2 tons of fruit in 1936. The annual growth may reach 20 ft. and there is scope for experiment in spacing and pruning and other cultural methods. Propagation by seed is easy, but the sex of the plants cannot then be determined until flowering. Grafting avoids this difficulty and results in earlier bearing by at least two years. Grafting a strong female scion and a weak male scion on the same root is sometimes practised.

305. EVREINOFF, A. 634.725
Ribes procumbens Pall. (Groseiller rampant.) (The creeping currant,
R. procumbens.)
Bull. Soc. nat. Hort. Fr., 1936, 3: 128, bibl. 1.

This creeping currant is a native of eastern Siberia and is known in Russia under the names of "Mokhovka" or "Mokhovaia Smorodina". Its principal characteristics, which are here briefly noted, include a creeping habit of growth, great fertility and marked resistance to frost. The berries are borne in clusters of 3 to 8 and mature late in the summer. The fruit is about twice the size of a black currant, juicy, slightly acid and with a distinctive but pleasant flavour. The plant requires a moist soil and does well under shady conditions. Seed or division provides the best means of propagation, since cuttings do not do well. In addition to producing fruit *R. procumbens* has an ornamental value, especially at the edge of ponds, etc.

306. Roodenburg, J. W. M. 634.75-1.588.2
Strawberries under neon light.
J. roy. hort. Soc., 1936, 61: 504-9.

In experiments made at the Horticultural Laboratory, Wageningen, Holland, it was found possible to produce under glass, by means of neon lighting, good quality strawberries which fetched high prices in February. The variety was Dutch Evern. It is essential to start the lighting in October, as once the plants incline to dormancy they will not force satisfactorily. The lighting plant used was a Philips Plant-Irradiator type 4310, 220 volt, 475 watt, at a distance of 4 ft. from the lower edge of the reflector to the bench. The illumination was about 45 foot candles neon light. The temperature maintained is not mentioned, but heating was applied on 14 October when the temperature fell to 46° F. The course of growth throughout the period is traced. The total cost per 24 plants including depreciation of apparatus, cost of material, wages, current, heating, etc., was one-third of the price received for their fruit. It is still not possible to begin to force strawberries by neon light in November or December.

307. WOODFIN, J. C. 634.8-1.544
Vine culture under glass.
N.Z. J. Agric., 1936, 52: 338-45, 53: 40-4, 156-60, 222-6, 263-70.

This practical article should be of considerable value to those who propose to grow vines under glass in New Zealand and elsewhere. The information is necessarily of a somewhat general character, but on the general principles laid down it should be possible to make the adaptations necessary for particular conditions. Among points considered in detail are: choice of position, type and size of vinery, erection of trellis, planting, training in early years and later, treatment of established vines, pruning, grape thinning, treatment during stoning and after-ripening processes, manuring, watering, varieties, pests and diseases. Ten varieties are recommended for New Zealand. Diseases, disorders and pests (and their control) noted are (1) fungus:—oidium or powdery mildew (*Uncinula necator*), grey rot (*Botrytis cinerea*), excoriosis (*Phoma flaccida*), ripe rot (*Glomerella cingulata*); (2) physiological:—shanking (footstalk of berries and branches wither, perhaps owing to sour soil), scalding (due to excessive light or temperature), thumb mark (due to bright sunshine after dull cold weather), warted leaves (due to admission of cold air current before foliage has dried), aerial roots (moist, warm atmosphere combined with lack of ventilation); (3) pests:—mealy bugs (HCN fumigation recommended), red spider (*Tetranychus telarius*), thrips.

308. HÉDIN, L. 634.8: 581.144.2
 Observations complémentaires sur l'émission des racines adventives chez la vigne. (Observations on the formation of adventitious roots in grape vines.)
Rev. Vitic., Paris, 1936, 84: 333-8.

Conclusions reached from studies on the localization of the meristematic tissue from which adventitious roots arise and on the different factors which influence the formation of this meristematic tissue are summarized and discussed in relation to the findings of other investigators.

309. ROCHAIX, J. 634.8-1.8
Fumure des pépinières de vignes. (The manuring of grape vines in the nursery.)
Rev. Vitic., Paris, 1936, 85 : 334-5.

The experiment summarized here appears to have been carried out in a nursery at Berne. The soil in question was of glacial origin, moderately heavy, containing only about 1% calcium carbonate and having a pH of 7.5. The whole area received a dressing of 1000 kg. of farmyard manure and 14 kg. of 18% P_2O_5 per acre prior to planting the grafted slips, and after planting 7.5 kg. calcium nitrate and either 7.5 kg. potassium sulphate or 12 kg. ammonium phosphate or both P_2O_5 and K_2O . Subsequently the following percentages of saleable plants were found : —basic dressing + P_2O_5 + K_2O 65.5%, basic dressing + K_2O 21.1%, and basic dressing + P_2O_5 15.1%. Particular emphasis is laid upon the very marked effect of K_2O , since this same area had received 3.5 kg. of 30% potash and two heavy dressings of farmyard manure during the preceding year, and might be thought to be well supplied with K_2O . The vines which had received K_2O showed better root development and were unaffected by frosts during the winter, whereas the majority of nurseries in the district suffered considerable losses from low temperatures.

310. LAGATU, H. AND MAUME, L. 634.8-1.85
Contribution à l'étude de l'influence alimentaire du superphosphate sur la vigne. (Contribution to the study of the nutritional effects of superphosphate on the vine.)
C.R. Acad. Agric. Fr., 1936, 22 : 1,018-31.

The experiment described in this paper was carried out in 1934 in Hérault on Aramon vines grafted on Rupestris du Lot and planted in 1912 on a calcareous soil. As potash is relatively deficient on many of these soils, a dressing of 150 g. of potassium chloride per vine was first applied over the whole area. The effect of different amounts of superphosphate (18% P_2O_5) on the nutrition of the vines was studied in 5 plots which received applications of 150, 200, 400, 500 and 0 (control) grams of superphosphate per vine. The influence of these applications on the NPKCaMg nutrition of the vines was determined by means of leaf analyses :—(1) with samples consisting of leaves from the base of lateral branches produced on short shoots and bearing two bunches of grapes, these samples being taken on 16 May, 15 June and 13 July, and (2) with samples consisting of leaves from the base of the first three fruiting branches produced on leader shoots, the samples being taken only on 16 May and 15 June. *Effect of superphosphate on the percentage of N + P_2O_5 + K_2O in the leaves.* Only the largest dressing of superphosphate (500 g.) was found to have increased the proportion of N + P + K in the leaves above that existing in the control plants. At the same time it is noted that the total NPK content was relatively low by comparison with contents found previously in leaves of the same grape variety growing at Grammont (*Ibidem*, pp. 363-82 ; *H.A.*, 1937, 7 : 50). *Effect of superphosphate on the balance between N, P, and K.* (a) *Seasonal variations.* The balance between N, P and K varied throughout the season and these variations were altered when different amounts of superphosphate were applied. Thus in the samples taken on 15 June the proportion of P_2O_5 was found to be at a maximum compared with samples taken at other dates in plots which had received 150 and 200 g. superphosphate, but at a minimum in the plot which had received 400 g. superphosphate ; (b) *Comparison with the NPK balance in the control plants.* The three smaller applications of superphosphate increased the proportions of both P_2O_5 and N by comparison with the controls. The largest application (500 g.), on the other hand, increased the proportion of K_2O , and had no effect on the P_2O_5 and N. (c) *Comparison with the optimum NPK balance.* In previous experiments the optimum ratio was found to be N, 41 : P_2O_5 , 8 : K_2O , 51. All treatments resulted in a relative deficiency of K_2O , despite the initial dressing of potash. The three smaller applications of superphosphate resulted in a NPK balance more remote from the optimum than did the control treatment of no superphosphate or the highest application, the effect of which was that of a potassic fertilizer. The relative deficiency of K_2O was more marked in

leaf samples from the laterals on leader shoots than in those from the laterals on the short shoots. *The Ca : Mg ratio.* In both types of leaf sample the CaO content was always below 5% and the highest Ca : Mg ratio occurred in the plants which had received the lowest (150 g.) and the highest (500 g.) applications of superphosphate. This effect was due in each case, however, to a relatively low MgO content and not to an increase in CaO, and there would, therefore, appear to be little danger of increasing the CaO content excessively by applying heavy dressings of superphosphate. The nutritional effect of basic slag on the vines was also studied and the results published separately. [For the principal effects of the two phosphatic fertilizers see abstract 311.—ED.]

311. LAGATU, H. AND MAUME, L. 634.8-1.85
 Contribution à l'étude de l'influence alimentaire du basiphosphate sur la vigne. (Contribution to the study of the nutritional effects of basic slag on the vine.)
C.R. Acad. Agric. Fr., 1936, 22 : 1,132-8.

The nutritional effect of basic slag on vines was studied in the same experiment as that noted above in abstract 310 on the effects of superphosphate, and the methods employed were identical. Basic slag (30% P_2O_5) was applied to two plots at rates of 124 and 250g. per vine respectively. Leaf analyses indicated that neither treatment increased the total percentage of $N + P_2O_5 + K_2O$ in the plants above that found in a control plot. Both applications of basic slag raised the proportions of P_2O_5 and N and reduced the proportion of K_2O in the dry matter of the leaves by comparison with control samples, and neither gave any indication of increasing the absorption of K_2O as was found in the case of the highest superphosphate dressing. By comparison with the optimum NPK equilibrium the samples from the control plot showed a relative deficiency of K_2O , and in these circumstances the application of basic slag accentuated the K_2O deficiency and proved of no benefit to the plants. The contents of CaO and MgO and the ratio between these two elements was not materially affected by the applications of basic slag, although in the case of leaf samples taken from laterals growing on leader shoots the Ca : Mg ration was somewhat lower than in other samples. No differences in yields were observed by the owner of the vineyard between the control and the slagged plots. From the results of this and the previously noted experiment with superphosphate, the authors conclude that both phosphatic fertilizers have proved equally available to the vines, although the one is soluble only in ammonium citrate while the other is soluble in water. The dry matter of the vines in question possessed a comparatively small total NPK content, and an incorrect balance between N, P and K, K_2O in particular being deficient. Both phosphatic fertilizers tended to increase the P_2O_5 in the plants at the expense of the K_2O , and thus accentuated still further the disequilibrium between N, P and K. It remains to be seen what effect this will have in future seasons, but the evidence suggests that, even though certain climatic factors might help to redress the balance between P_2O_5 and K_2O , the application of a heavy dressing of potash is advisable.

312. REED, C. A. 634.54
 New filbert hybrids.
J. Hered., 1936, 27 : 427-31.

An account is given of the breeding of new hybrid filberts in the Eastern United States during the last 18 years. It has mainly consisted of crossing one of the Eastern native hazels, *Corylus americanus* Marsh, with some of the leading European varieties. Out of about 4,000 hybrids so produced some 50 are under close observation, and many of these show great promise. It is noted that two such hybrids are now on the market, namely Bixby (Rush × Italian Red) and Buchanan (Rush × Barcelona). Rush has been used very often as the pistillate parent, while among European pollen varieties used are Bolwyller, Kentish Cob, Red Aveline, White Aveline, Red Lambert, White Lambert, Imperial and Brixnut. The general peculiarities of the resulting hybrids are briefly discussed.

313. BARTON, L. V. 634.51/2-1.521.5
Seedling production in *Carya ovata* (Mill) K. Koch, *Juglans cinerea* L.
and *J. nigra* L.
Contr. Boyce Thompson Inst., 1936, 8: 1-5, bibl. 7.

The author's experiments described here lead her to the following conclusions: Pretreatment for 2-4 months at low temperatures in a moist medium was necessary for seedling production in the butternut, *J. cinerea*, and the black walnut, *J. nigra*. Seedling production of hickory, *C. ovata*, was improved by pretreatment in moist soil for 1-5 months at 3° C. or 10° C. Good seedling stands of these three forms were produced by autumn planting when protection was given to the seeds by a mulch or board cover.

314. INSTITUT FÜR OBSTBAU, BERLIN. 634.51-1.541+1.541.5
Die Walnuszveredlung.* (Vegetative propagation of the walnut.)
Merkbl. Inst. Obstb. Berlin, 5, 1936, pp. 15.

In this well-illustrated publication a full account is given of recent German work aiming at the home production of valuable fruit bearing walnuts in Germany. Most of the work described in the present article was done with *Juglans regia* stocks [varieties not named.—Ed.], but it is stated that *J. rupestris*, *J. Sieboldiana*, *J. mandschurica*, *J. cinerea* and *J. cordiformis* are also under trial. In general the work is similar to, but would appear to be on a rather more ambitious scale, than that reported by Witt in England.† The operations of both budding (ring) in the open and grafting in the heated propagating house are described in detail. It is interesting to note one or two points in which German practice differed from English. Thus in the German trials the grafts were planted in soil in the propagation beds and potting was not done until after plants had made several centimetres growth. Again in Germany considerable success resulted from grafting in the beginning of September. At Malling this has not been attempted, though grafting with green shoots in July and August has been fairly successful. The illustrations of technique, propagating house and grafts are clear and helpful.

PLANT PROTECTION OF DECIDUOUS FRUITS.‡

315. HILL, H. AND DAVIS, M. B. 634.11-2.19
Physiological disorders of apples.
Sci. Agric., 1937, 17: 199-208, bibl. 10.

Internal cork was produced experimentally by waterlogging or subjecting to drought pot-grown trees which had borne healthy fruit for 10 years previously. Excessive applications of nitrogen to these plants was also correlated with corky core. Physiological troubles were usually confined to heavily manured orchards, even in districts where adverse soil physical conditions existed. The usual conditions associated with disorders such as internal cork, corky core or tree pit were: high carbonate lime soils; high percentage of nitrogen and organic matter, particularly in association with shallow rooting due to compact subsoils; soil moisture excesses and deficiencies in association with high percentage of nitrogen and organic matter; low available potash and a high phosphorus-potassium ratio, especially in the lower soil horizons.

316. HARRIS, J. B. 632.111: 634.1/8
Frost prevention.
J. Dept. Agric. S. Aust., 1936, 40: 162-5.

The author reports the recommendations drawn up by a sub-committee of a meeting held at Mildura on 10 August, 1936 under the auspices of the Australian Dried Fruits Association

* Abridged translation available.

† Witt, A. W. The vegetative propagation of walnuts. *Annu. Rep. East Malling Res. Sta.*, 1926-7, Suppl., A10, 1928, pp. 60-4.

‡ See also 480, 481, 482.

to discuss frost protection. They deal with the following points: *Direct heating.* This is essential. The hot air rises to a height where it meets air of a corresponding temperature at 10-25 ft. [In England generally considered to be nearer 50-100 ft.—ED.], whereupon it gradually fills up the space between this ceiling and the ground. *Temperatures at which heaters should be lighted to ensure protection.* Safe low temperature limits based mainly on the bulletin by Watt, Commonwealth Meteorologist, on "Frost risks and frost forecasting" are given for 15 types of fruit. *Types of heater.* Oil is preferable to briquettes as fuel, the 5 quart type of oil burner being preferred. *Thermometers.* Good mercury thermometers can be used for ordinary observation, but a Negretti and Zambra minimum thermometer is recommended as the best for use as a main check on all others. The danger is stressed of using the U type alarm thermometer and the reader is referred to the author's bulletin, "Frost prevention by orchard heating," *Bull. Dep. Agric. S. Aust.*, 294, 1934, pp. 163-77; *H.A.*, 1935, 5:41. [Where a diagram and description are given of a suitable type, in which a bell rings on the circuit being broken and not when the circuit is made.—ED.] *Subsidiary agencies.* (a) Standing cover crops accentuate the severity of frosts and should be turned in before the frost period occurs. (b) Cultivation should be avoided as much as possible during the danger period. (This would mean no working of the ground in the case of vines for a week or two before the period.) (c) The nearer irrigation can be applied to the beginning of the frost period, the greater the degree of safety. (The flow of sap in vines and the vitality effected by the availability of fertilizers helps. Also wet ground does not give off its heat so readily.) (d) The destruction of timber fringes round frost affected areas assists in the control of frost. (Recent tests show that differences of temperature of up to 6 degrees have been found between mallee belts and cleared land on the same level, half a mile away.) (e) Very late pruning, about 10 days before sprouting, retards sprouting and may be of value in sections particularly liable to frosts.

317. STARK, A. L. 634.11-2.111
Unfrozen water in apple shoots as related to their winter hardiness.
Plant Physiol., 1936, 11: 689-711, bibl. 59.

The author gives a brief but useful note of the literature dealing with the influence of freezing temperature on plants and concludes his paper with an extensive bibliography on the subject. The material used by him consisted of shoots from 15 standard American horticultural varieties of apple. These were subjected at monthly intervals to the heat-of-fusion method, a procedure by which the change in temperature of a known quantity of water caused by the addition of frozen material is determined. Information on this point plus temperature, weight and specific heat of the material makes it possible to calculate the quantity of frozen water in the sample. The following notes are from the author's summary:—In general the experimental data supported the theory that the capacity to retain water against freezing is associated with winter hardiness of apple shoots. Statistical analysis indicated that varieties differ in their capacity to retain water against a freezing temperature of -20° C. It was, however, impossible on this basis to separate the varieties into a hardy and a tender class.

318. THOMPSON, D. J. 634.3-2.111
Survey of wind machines under freeze conditions.
Calif. Citrogr., 1937, 22: 208-10.

The efficiency of wind-creating machines in protecting fruit during the severe cold weather in California during the past winter is examined. Thermograph records in a 10-acre orchard at Lindsay equipped with a wind machine show a rise of temperature within the orchard of 3 to 4 degrees which was sufficient to save the fruit until the outside temperature fell to 16.5° F., the inside being then 20° F. Other orchards similarly equipped had, in the absence of thermograph records, to be judged by appearance alone, and some of these looked worse, though many looked better, than orchards without blowers, but on the whole opinion is in favour of the wind machine. The subject is now under investigation by the agricultural engineering and other interested sections of the University of California.

319. FURNEAUX, B. S. and KENT, W. G. 634.1/2-2.19
"The death." A trouble of fruit trees due to root su location.
Sci. Hort., 1937, 5: 67-77, bibl. 13.

This somewhat dramatic name is given in parts of Sussex to a trouble affecting fruit trees involving the sudden collapse and often death of the tree shortly after coming into leaf. The phenomenon is associated locally with the combination of wet weather and a clay soil. Recently the trouble spread to other counties and on investigation many other fruits besides apples were found to be suffering. In all cases examined the roots had perished from lack of aeration caused by faulty drainage, or, if in well-drained soils, from water-logging through the cavity which the swaying of the tree in the wind had worked in the soil at the base of the trunk. In these latter cases the soil around the tree had been so completely puddled as entirely to exclude the air for a sufficient distance and thus partially or wholly suffocate the roots. Certain varieties seem to be more susceptible than others and these are recorded. In every orchard except one Bramley's Seedling was the least affected. The soils involved and the influence of cultural management in remedying the trouble are discussed.

320. DIPPENAAR, B. J. 634.22-2.112
Cause and control of heat spot of plums.
Fmg S. Afr., 1937, 12: 83-5.

"Kelsey spot" of plums is caused by excessively high internal fruit temperatures and would therefore be more aptly termed "heat spot". Studies of temperatures in relation to the disorder during the 1935-6 season are reported. Other factors besides high temperatures have been found to affect the susceptibility of Kelsey and other plum varieties. Fruits that would normally ripen early in the season are much more susceptible than others on the same tree which ripen towards the end of the season. Locality also has a marked influence. Thus, whereas the mean maximum temperature during any of the months of December, January or February was higher at Ceres than at Elgin, the percentage of spotted fruit from a plot in the former district was 6.9 and from a plot in the latter 45.4. Attempts to control heat spot by applying irrigation water were unsuccessful, as were most fertilizer treatments. Applications of complete NPK fertilizer reduced the percentage of heat spot slightly, but not to an extent which would compensate for the cost of the treatment.

321. KOZLOWSKI, A. 632.19: 634.1/7
Little leaf or rosette of fruit trees in California.
 CHANDLER, W. H. AND HOAGLAND, D. R.
Comments on the article by A. Kozlowski on "Little leaf or rosette of fruit trees in California".
 KOZLOWSKI, A.
Soil conditions in relation to little leaf or rosette of fruit trees in California.
Phytopathology, 1935, 25: 275-8, 1935, 25: 522, and 1936, 26: 1,041-9, bibl. 7.

In his first paper Kozlowski describes investigations of the factors responsible for the production of abnormally small leaves in certain peach, apple and plum trees. In the case of the peach and apple trees he came to the conclusion that the subnormal size of the leaves was associated with anaerobic subsoil conditions which caused serious injury to the roots and led to the trees being readily invaded by *Monilia* sp. (closely resembling *M. cinerea*). The leaves were also chlorotic and mottled when the soil reaction was alkaline. In the case of the plum trees drought followed by infection of the shoots with *Monilia* sp. was considered responsible for little leaf. These conclusions were supported by the results of pot experiments in which trees were induced to form small leaves under the influence of anaerobic conditions, and by the addition of a culture medium of denitrifying bacteria of the *Pseudomonas* group to sand in which the trees were growing. Some positive results were also obtained in attempts to induce the formation of small leaves through artificial infection by *Monilia* sp. Chandler and Hoagland, in a brief note, criticize these conclusions as being "irrelevant or inconsistent with well-established

facts" and add that "Kozlowski omits all reference to the most fundamental aspect of their experiments on little leaf, namely, the specific function of zinc, which clearly is not merely that of a fungicide". Kozlowski, in his second paper replies to these criticisms and presents chemical analyses of water extracts from the soil of the affected orchards described in his first article in support of his conclusions. He then in turn proceeds to attack the hypothesis of Chandler and Hoagland, that zinc has a specific function, on the grounds that after a critical examination of their published results he could not find a single fact which supports it nor which could contradict his own conclusions that little leaf is due, not to a supposed single factor, but to the concerted action of various factors, such as climate, soil conditions and micro-organisms. He considers that the beneficial effects obtained from soil applications and sprays of zinc sulphate have been due to improved soil conditions. Zinc sulphate precipitates soil colloids and simultaneously changes the hydrogen-ion concentration of the soil, thereby improving soil ventilation and contributing, by base exchange and by the action of its anion, to an increase in available nutrient elements in the soil. Evidence that such favourable changes in soil conditions occurred in an affected peach orchard is presented. It is further suggested by Kozlowski, but without much enthusiasm, that any beneficial effect which may result from applying zinc compounds through holes into the trunks of diseased trees may be due partly to some possible fungicidal action, and partly to a reaction, whereby certain nutrient elements are released from the xylem and made available to the buds.

322. MAIER, W. 546.27 : 634.8-2.19
 Bormangelerscheinungen an Rebsämlingen in Wasserkulturversuchen.
 (Boron deficiency symptoms in vine seedlings grown in water cultures.)
Gartenbauwiss., 1936, 11 : 1-16, bibl. 18.

The author's experiments show the absolute necessity of the presence of boron [the actual dose given was 0.6 mg. per litre of solution.—ED.] for normal growth in seedlings of Riesling vines grown in water culture. Deficiency symptoms which could be seen at the growing point, in the length of the internodes, in the size, colour, shape and position of the leaf and in the leaf stalk, were, generally speaking, weakness of growth in top and roots and lightness of weight.

323. ASKEW, H. O. 634.11-2.19 : 546.27
 Internal cork of apples. Progress report on boron investigations at the
 Cawthron Institute.
Orchard. N.Z., 1936, 9 : 185-8, being *Bull. Cawthron Inst.*, 24.

A survey of the boron status of orchard soils has shown that in the case of soils associated with internal cork the average boric oxide content in the top 6 in. was only 0.2 to 0.3 p.p.m. of dry soil, whereas in soils producing healthy fruit the content ranged from 0.35 to 1.10 p.p.m. Apart from this note on the boron status of soils the investigations outlined in this paper are the same as those already described in greater detail in *J. Pomol.*, 1936, 14 : 227-45 and abstracted in *H.A.*, 1936, 6 : 466.

324. ASKEW, H. O. AND THOMSON, R. H. K. 634.11-2.19
 Occurrence of internal cork of apples in Central Otago, New Zealand.
N.Z. J. Sci. Tech., 1937, 18 : 661-4.

A pitting of apples in Central Otago is considered to be identical with internal cork of apples in the Nelson District.* Incidence of the ailment is correlated directly with low boron content of soil and fruits.

325. YOUNG, L. C. AND BAILEY, C. F. 634.11-2.19
 Progress report on the investigation of corky core of apples.
Sci. Agric., 1936, 17 : 115-26, bibl. 4.

The period covered is 1934 and 1935, the districts were Gagetown and Fredericton, New Brunswick, and the varieties Fameuse and McIntosh. Treatments were the application of

* Askew, H. O. The boron status of fruit and leaves in relation to internal cork of apples in the Nelson district. *N.Z. J. Sci. Techn.*, 1935, 17 : 388-91, *H.A.*, 1935, 5 : 385.

boron, magnesium or zinc in the form of wet or dry injections, by spraying, or by ground applications. Magnesium and zinc failed to control corky core and boron occasionally failed. In most instances, however, boron exerted important control. Corky core occurs in orchards of all degrees of fertility and in practically wild trees. Trees affected one year may be free the next. In non-affected areas root distribution tended to be deeper than in affected areas. Dead roots were few in all areas. Anatomical investigation showed no correlation between the plugging of the vascular ray cells and disease. No correlation could be established between soil factors and cork incidence. Data concerning the boron content of the soils were not available. Boron applied as a spray would appear to be a promising substitute for injection. Soil applications of borax at the rate of 4 lb. per 20-year-old tree had not damaged the trees after 7 weeks.

326. DE LONG, W. A. 634.11-2.19
Variations in the chief ash constituents of apples affected with blotchy cork.
Plant Physiol., 1936, 11: 453-6, bibl. 5.

In 1932 analysis of the inorganic contents of Fallwater apples showed that those affected with blotchy cork contained less CaO than unaffected fruits. In 1934 Stark apples, 30 each from 5 different sources in Nova Scotia, were submitted to similar analysis and results confirmed those of 1932. A consideration of the relevant facts known on growth and absorption leads the author to suggest that a low calcium content in apples affected with this disorder may arise as the result of competition between leafy shoot and fruit tissues for this element during these early stages of growth. Possibly this apparent calcium deficit may play a part in the origin of the lesions typical of this disorder.

327. MCCALLAN, S. E. A. AND OTHERS. 632.184
Hydrogen sulphide injury to plants.
Contr. Boyce Thompson Inst., 1936, 8: 189-97, bibl. 14.

The toxic action of H_2S gas on 29 species of green plants was studied in glass fumigation chambers out of doors during the growing season. Typical symptoms of injury, which were usually fully apparent within a few days of treatment, were a scorching of the young shoots and leaves, and basal and marginal scorching of the next older leaves, mature leaves being unaffected. These symptoms appeared to be identical with those produced by a 1 in 20 lime sulphur spray on a number of plants including aster, tomato, tobacco and sunflower. The different species varied widely in their response to H_2S . Some, such as apple, cherry, peach, strawberry and carnation showed no appreciable injury at concentrations below 400 p.p.m.; others, such as rose, pepper, nasturtium, castor bean, gladiolus, sunflower and cornflower, showed moderate injury at concentrations from 40 to 400 p.p.m.; while there were others, including Turkish tobacco, tomato, aster, kidney bean, cucumber, salvia, poppy, calliopsis, cosmos and radish, which were slightly injured at concentrations below 40 p.p.m. and showed severe injury and death at concentrations above 400 p.p.m. Temperature proved to be as important a factor in producing injury as concentration, the amount of injury increasing rapidly with increases in temperature. Finally there was some indication that wilted tomato and buckwheat plants were less sensitive to H_2S injury than were normal turgid plants.

328. KUNKEL, L. O. 634.25-2.8
Peach mosaic not cured by heat treatments.
Amer. J. Bot., 1936, 23: 683-6, bibl. 8.

Peach mosaic was found to be transmitted readily by budding, but not by juice inoculations. Mosaic virus was not inactivated in bud sticks held at 35° C., 42° C. or 50° C. for periods of time approaching the limit of endurance of the tissues. It is, therefore, concluded that heat treatments—found successful with yellows, rosette, little peach and red suture—will probably not be effective for the cure of peach mosaic. [From author's summary.]

329. KUNKEL, L. O. 634.25-2.8
Heat treatments for the cure of yellows and other virus diseases of peach.
Phytopathology, 1936, 26 : 809-30, bibl. 15.

Peach yellows was cured by incubating potted trees in a hot room held at a temperature of 34.4° to 36.3° C. Trees that were cured made normal and apparently healthy growth. The yellows virus was destroyed in 4-6 days in slender young branches and in young trees, in about 2 weeks in thick stems and branches, and in 2 to 4 weeks in large roots imbedded in moist soil. In cases where the treatment was too short to destroy the virus in all parts of the tree symptoms of yellows would reappear in from 1 up to 8 months later. All treated trees remaining healthy for a vegetative period of 8 months were, so far as the author's experience goes, permanently cured. Trees were only seriously injured when treated for periods considerably longer than were necessary to destroy the virus. Dormant trees were cured by immersion for about 10 minutes in water held at 50° C. Yellows virus in buds was inactivated by immersing the bud sticks in water at 34-35° C. for 4-5 days, at 38° C. for 11 hours, at 42° C. for 40 minutes, at 46° C. for 15 minutes, at 48° C. for 14 minutes, at 50° C. for 3-4 minutes, at 54° C. for about 1½ minutes, and at 56° C. for 15 seconds. The bud tissues were able to endure much longer treatments than were necessary to destroy the virus. Three other virus diseases, little peach, red suture and rosette, were also cured by treatments that proved effective against yellows, but rosette was somewhat more refractory than the other three diseases.

330. BRANAS, J. AND BERNON, G. 634.8-2.8
Recherches sur le traitement de la panachure. (Investigations on the control of yellow streaking of vine leaves.)
Rev. Vitic., Paris, 1936, 85 : 26-7.

The streaking or partial yellowing of vine foliage, which forms the subject of this article, is not associated with the detrimental effects of calcium in the soil, nor can it be cured like chlorosis by applications of iron salts. It occurs only on vines affected by court-noué or which appear to be in a condition to develop this disorder. It is even more readily transmitted by grafting than is court-noué. Experiments have shown that an aqueous suspension of lampblack, 8-10 parts, in 100 parts water with 0.3% gelatine in solution sprayed thoroughly over affected plants will result in the reappearance of the green colour after 24 hours or less in leaves turning yellow, or in a deeper yellow colour in leaves which have become a pale yellow or white. Scorching of the foliage may also occur, but this may be avoided to some extent by choosing suitable times to spray and by watering the plants. It is not yet known how long the effects of the treatment will last, nor exactly what is the nature of the action of the spray. It is concluded, however, that the coating of lampblack over the plants results in an increase in the temperature of the leaves and that this is primarily responsible for any scorching that may occur.

331. THOMAS, H. E. AND HILDEBRAND, E. M. 634.22-2.8
A virus disease of prune.
Phytopathology, 1936, 26 : 1,145-8, bibl. in text.

The symptoms of a disease, first noted on prune trees in Niagara County, New York, in 1930, are described. They include reduction in size and distinct narrowing of affected leaves and suppression of serration and pubescence. The leaves become abnormally rugose, especially near the mid-rib, and mottled, and the leaf blade is somewhat thickened. All leaves on a given shoot are affected, those at the base particularly so, and internodes are shortened in varying degrees. Diseased trees may blossom profusely but only an occasional fruit is matured on parts showing foliage symptoms. In a number of experiments the disease has been transmitted by grafting from infected prune shoots to prune and plum trees, but the virus appears to spread only slowly through inoculated trees. Attempts to infect peach and cherry trees by the same method have so far failed, as have attempts to transmit the virus by means of the aphids, *Myzus Mahaleb* and *Aphis setariae*. The relation of this disease to virus diseases of

stone fruits in other areas has not yet been established with any certainty, but it is thought unlikely that it will prove identical with any so far studied in plums and prunes in North America.

332. LINK, G. K. K. AND WILCOX, H. W. 634.11-2.314 : 631.8
Relation of nitrogen-carbohydrate nutrition of Stayman apple trees to susceptibility to fire blight.

Phytopathology, 1936, 26 : 643-55, bibl. 35.

Shoots of Stayman apple trees grown in quartz sand were rendered either succulent by applying a complete nutrient solution containing $\text{Ca}(\text{NO}_3)_2$, or woody by applying the same solution plus CaCl_2 , but without the nitrate. The shoots were inoculated with *Erwinia amylovora*, and it was found that while actively growing succulent shoots were susceptible, shoots in which the tissues had matured to a stage at which they could not be restored to meristematic activity were resistant. Under similar conditions of light, temperature and moisture, application of nitrates favoured a metabolic status resulting in succulence and susceptibility to the organism, whereas non-application of nitrates favoured early cessation of meristematic activity resulting in woodiness and resistance to infection. In the course of the investigation microscopic examinations were made of sections of the shoots of the minus-N trees at the time when they had ceased elongation and developed terminal buds. These revealed an abundance of starch in the pith, xylem, rays, pericycle and inner cortex. The middle and lower internodes showed more starch, more thick-walled parenchymatous and sclerenchymatous elements, and more accompanying atrophy of protoplasts than the upper internodes. The shoots of the plus-N trees were still elongating at this time and corresponding sections of the axis showed less starch, less thick-walled parenchyma, fewer sclerenchymatous elements and fewer atrophied protoplasts than the shoots of minus-N trees. The lower internodes of the plus-N shoots resembled the upper internodes of the minus-N shoots. It is also noted that a single application of nitrate to half the trees in the minus-N series led to some diameter increase and elongation of internodes, but did not break their dormancy.

333. GRUBE, N. H. 632.314 : 634.23
Bacteriosis of cherry trees* : relative susceptibility of varieties at East Malling.

J. Pomol., 1937, 15 : 25-34, bibl. 4.

Observations have shown that under East Malling conditions great differences exist in the susceptibility of different varieties of sweet, acid and duke cherries. Over 100 varieties are tabulated as showing extreme, considerable, slight or very slight susceptibility. The symptoms of infection on leaf, spur, branch and stem and on the different varieties also vary. Rootstocks do not appear to influence susceptibility directly, thus susceptible scions may be killed by bacteriosis right to the point of union, leaving the stock uninjured. The possible influence of local conditions is discussed.

334. WORMALD, H. 634.314 : 634.23
Bacteriosis of stone fruit trees in Britain. VI. Field observations on bacteriosis of sweet cherry trees.

J. Pomol., 1937, 15 : 35-48, bibl. 21.

Bacteriosis, due to *Pseudomonas prunicola* and *P. mors-prunorum*, causes serious damage in many English cherry orchards. The symptoms, which are described, are in sweet cherries : stem, crotch and branch cankers, shoot wilt, bud and spur blight, leaf spots and, occasionally, fruit spots. Among varieties very commonly attacked are Bigarreau de Schrecken, Cluster

* Caused by *Pseudomonas prunicola* and *P. mors-prunorum*.

Black Heart, Black Tartarian, Emperor Francis, Bradbourne Black and Black Eagle, while Frogmore and Governor Wood appear to be less affected than other varieties. Notes are given on records of work on this disease of cherry trees in Poland, Germany and North America. A comparison is made of the bacteriosis of cherry with that of other *Prunus* species. Control has been or is being sought for along the following lines:—Avoidance of mechanical injury during autumn, winter and early spring; spraying the foliage with bordeaux—this has given some control for the leaf spot stage but there is danger of spray injury; the use of resistant varieties, e.g. one of the Devonshire Mazzards, as frame builders; and liming—observations made to date do not confirm the efficacy of this treatment. The illustrations given of disease symptoms are particularly clear.

335. WILSON, E. E. 632.3 : 634.13 + 634.22
Symptomatic and etiologic relations of the canker and the blossom blast of *Pyrus* and the bacterial canker of *Prunus*.
Hilgardia, 1936, 10 : 213-40, bibl. 21.

The main object of the studies described here was to establish the relation between a canker and blossom blast of pear and bacterial canker of stone-fruit trees, caused by *Phytophthora Cerasi*. The diseases of the two hosts were observed for a number of seasons to obtain information concerning the seasons of activity of the organisms, the parts of the host attacked and the character of the symptoms; and the bacteria were inoculated at various times into *Pyrus* sp. and into 5 species of *Prunus* to determine pathogenic similarities. The growth of the bacteria was also compared in various standard media. The results of the studies are discussed in relation to the findings of other workers and lead to the following conclusions:—(1) The limb canker and blossom blast of pear are phases of the same disease, which also attacks dormant buds, twigs and fruit. (2) The pear and stone-fruit diseases exhibit similarities as to parts of the host attacked, symptoms, and the season of activity. Furthermore the bacteria from the two hosts were identical in the inoculation and cultural tests. (3) The inoculation and cultural tests support the view that *Phytophthora utiformica*, *P. citriputeale* and a culture furnished by Rosen in Arkansas are identical with the stone-fruit organism, *P. Cerasi*. The author considers, therefore, that they should be given the same specific name, and suggests that the bulk of the evidence in the literature points to *P. Syringae* as the correct name. A bacterium recently isolated by Roberts and designated *P. papulans* has proved to be an unrelated species.

336. RIKER, A. J. 634.11-1.541.11/12 + 632.1/4
Recent developments in control of graft knots on nursery apple trees.
J. econ. Ent., 1936, 29 : 956-60, bibl. 2.

Graft knots on nursery apple trees grown from piece root grafts have been the subject of a special investigation in the U.S. since 1924. The literature from these and other investigations has been reviewed in an earlier paper,* and the present account merely summarizes the information obtained to date. It has been found that there are three factors primarily responsible for the development of union overgrowths:—(1) The nature of the graft wound which may lead to the formation of excess callus. These wound overgrowths may be avoided by substituting budding for grafting and may be largely eliminated in grafts by selecting stocks and scions of equal size, seeing that they are well fitted, and wrapping them with suitable material. (2) Crown gall, caused by *Phytophthora tumefaciens*, and (3) infectious hairy root, caused by *P. rhizogenes*, are the two other principal causes of graft knots, and methods of preventing infection by these bacteria are outlined. Finally it is noted that the use of a wrapper of nurseryman's adhesive tape containing mercuric chloride (1 : 300 by weight) has proved most satisfactory in preventing the formation of excess callus and has usually destroyed the relatively few bacteria on the surface of the wood. This wrapper will ordinarily protect the union for several months while gradually diminishing in tensile strength.

* Riker, A. J. and others. *J. agric. Res.*, 1934, 48 : 913-39, bibl. 50. *H.A.*, 1934, 4 : 376.

337. HORTICULTURAL DIVISION, DEPARTMENT OF AGRICULTURE, SOUTH AUSTRALIA. 634.11-2.42
Apple scab.

J. Dep. Agric. S. Aust., 1936, 40 : 331-3.

The life history of the fungus is outlined. Pending the results of work initiated in 1936 the following recommendations are made for the control of scab in South Australia : (1) Plough orchards, if possible, before bud break to minimize primary infection. (2) In wet districts adopt the following spray programme :—(a) bordeaux 6-4-40 when about three-quarters of the buds are showing green tips, (b) lime sulphur, 1 in 40 to 1 in 50, between open cluster and pink stages, (c) lime sulphur, 1 in 80, at petal fall, and (d) thereafter lime sulphur, 1 in 80 to 1 in 100, at fortnightly intervals, according to weather conditions. (3) In dry districts a spray at the pink stage may prove sufficient, but a spray at the green tip stage is considered a better insurance.

338. HERBST, W. AND OTHERS. 632.42
 Vergleichend-morphologische Studien an verschiedenen *Venturia*arten.
(Comparative morphological studies on different *Venturia* strains.)
Gartenbauwiss., 1937, 11 : 183-207, bibl. 16.

An illustrated comparison is made of the development in culture medium of many types of *Venturia*, the differences in their hyphae, mycelium and conidia being clearly shown.

339. SCHMIDT, M. 632.42 : 634.11
Venturia inaequalis (Cooke) Aderhold. VII. Zur Morphologie und Physiologie der Widerstandsfähigkeit gegen den Erreger des Apfelschorfes.
(*V. inaequalis* VII. Morphology and physiology of resistance capacity to apple scab fungus.)
Gartenbauwiss., 1937, 11 : 221-30, bibl. 10.

The author compares the different phenomena arising in the "Gelber Edelpfappel" variety when inoculated with a strain of *V. inaequalis* to which it is susceptible with those occurring when it is inoculated with a strain to which it is resistant. In the latter case the growth of the fungus mycelium in the tissue of the host is checked and restricted to very small areas by the occurrence of necrotic spots, and is finally brought to a complete stop.

340. LOEWEL, E. L. 632.42
 Ob 72, ein neues Spritzmittel gegen *Fusicladium*. **(Ob 72, a new spray for scab.)**
Gartenbauwiss., 1937, 11 : 208-20, bibl. 9.

Comparative tests with Gravenstein, Belle de Boskoop, Echte Boiken, Rehder's Boiken and other apples and pears, using this product of the I. G. Farbenindustrie and lime sulphur, show that Ob 72 is just as efficient as lime sulphur lead arsenate against scab and even equal to the copper sprays. With one exception no spray damage has resulted from its use. Crude nicotine can be mixed and used with it satisfactorily. Bees are not endangered by its use.

341. HERBST, W. 632.42 : 634.13
Venturia pirina Aderhold. II. Die Abhängigkeit der Formenverbreitung von meteorologischen Faktoren. **(Pear scab. II. The influence of meteorological factors on the spread of its different strains.)**
Gartenbauwiss., 1937, 11 : 35-53, bibl. 11.

The author discusses the extent to which uniformity exists at different centres in Germany with regard to the strains of pear scab fungus found there, and proceeds to consider what factors, meteorological, climatic or geographical are likely to be responsible for uniformity or lack of it.

342. HORTICULTURAL DIVISION, TASMANIAN DEPARTMENT OF AGRICULTURE.

634.13-2.42

The control of black spot on pears.*Tasm. J. Agric.*, 1936, 7 : 110-3.

Application of bordeaux mixture at the "green tip", "pink" and "calyx" stages and in three cover sprays about 1 month apart increased the proportion of Winter Nelis fruit free from black spot (caused by *Venturia pirina*) from 0.5% to 88%, and of clean Beurré Bosc fruit from 5.0% to 81%. The control exerted by strong bordeaux applications (6-4-40 in the earlier down to 1½-2-40 in the later sprays) was not markedly better than that produced by weaker solutions (4-4-40 in the earlier down to 1-1-40 in the later sprays). The quantity of fruit seriously russeted by the stronger bordeaux was negligible. Omission of the "calyx" spray reduced the number of clean fruit to only 60%, although it also largely eliminated what little spray injury there was. Observations on adjacent trees which had received only lime-sulphur throughout the season indicated that these produced over 50% of excessively spotted fruit.

343. BAKER, K. F. AND HEALD, F. D.

632.48 : 634.11

The effect of certain cultural and handling practices on the resistance of apples to *Penicillium expansum*.*Phytopathology*, 1936, 26 : 932-48, bibl. 31.

Applications of N, P and K fertilizers, alone or in combination, in Washington State during 1933 increased slightly the rate of decay due to *P. expansum* in Jonathan apples held in cold storage. There was, however, no constant relationship between the applications of any of the fertilizers and the resistance of the fruit to infection at the lenticels, and from these limited data it appears that fertilizer practices are unimportant as affecting susceptibility to blue-mould. The rate of decay and the number of lenticel infections in Delicious and Winesap apples was greater in fruit picked at prime maturity than at early maturity. The length of the storage period did not affect the rate of decay until after 180 days, when it materially increased. Similarly the incidence of lenticel infections was unaffected by the length of the storage period up to 180 days, but after this a slight increase was sometimes shown. Winesap proved more resistant to lenticel infection and to the radial advance of the fungus in the tissues than did Delicious and Jonathan. The conclusion is reached that the practice of leaving fruit on the tree past the stage of prime maturity should be discontinued in areas where blue-mould decay is troublesome.

344. SCHMIDT, M.

634.23-2.41

Infektionsversuche mit *Sclerotinia cinerea* an Süß- und Sauerkirschen.**(Infection trials with *S. cinerea* on sweet and sour cherries.)***Gartenbauwiss.*, 1937, 11 : 167-82, bibl. 13.

The infection technique is described and the results of infecting sweet, sour and hybrid cherries in different ways are discussed. Generally speaking, sour cherries were found to be more susceptible than sweet.

345. ARK, P. A. AND THOMAS, H. E.

632.651.3 : 634.1/8

Anguillulina pratensis* in relation to root injury of apple and other fruit trees.Phytopathology*, 1936, 26 : 1,128-34, bibl. 8.

The nematode, *Anguillulina pratensis*, has been found in the roots of apples, plums, peaches, pears and grape vines affected by rosette or little leaf. The symptoms produced by the nematode in apple roots are described. Two different species of bacteria, the one identified as *Pseudomonas fluorescens* and the other as yet unidentified, have been consistently found in association with the nematode infested roots. Inoculum of these two bacteria added separately and in combination to sterilized soil in which 50 apple seedlings were growing did not, however, result in

diseased roots in the absence of the nematode. In another experiment apple trees grown in non-sterilized soil heavily infected with *Anguillulina pratensis* and in sterilized soil to which nematodes had been added made much less thrifty growth, although lacking symptoms of disease on leaves and stems, than did similar trees grown in sterilized soil without nematodes. The possibility that the nematodes provide openings into the roots for the entry of micro-organisms or the absorption of toxic materials from organisms around the roots is envisaged. The presence of toxic materials in the root zone has been demonstrated by the wilting of detached apple shoots placed either in the filtered leachate of soil from the neighbourhood of affected roots or in the filtrate from pure cultures of organisms isolated from the root zone of affected apple, apricot and peach trees.

346. TURNBULL, J. 632.95
Fruit tree spraying in 1936.
J. Minist. Agric. Lond., 1936, 48 : 1,145-57.

Costs are given, based on the actual spraying of 50 acres or more of bearing apple trees, of spraying average bush trees and exceptionally large half-standards by means of a central plant and underground pipes and average half-standards by means of a large portable pumping outfit and portable pipes. Some costs incurred when using the latest type of American spraying are also included. The author discusses the merits of the different systems. He himself considers that though the mobile system is very valuable for dealing with young plantations or with very tall trees in old orchards where it is an advantage for the sprayer to stand on top of his outfit, yet the central system with underground pipes is to be preferred for orchards in profitable bearing.

347. DULLUM, N. AND ESBJERG, N. 632.42 : 634.11
Forsøg med rentabiliteten ved sprøjtning af æbletræer. II. (Studies on the benefits of apple spraying. II.) [English summary.]
Beretn. Forsøksv. Planteb. Kbh. 300, 1937, pp. 37, being reprinted from *Tidsskr. Planteavl.*, vol. 42.

After noting results achieved in previous work and reported in earlier papers the authors describe experiments started at Blangsted in 1929. The object was to compare the benefits of different combinations of bordeaux and lime-sulphur sprays. The apple varieties included Cox's Orange, Cox's Pomona and Lane's Prince Albert among English apples, all of them being budded on Malling type V rootstock. The treatment plots were duplicated, there being 46 trees in each plot. Original spacing was 3×2.5 metres. The trees were planted in 1928 and half of them were removed in the winter of 1934-5. Eight different treatments were given in addition to the control or nil treatment. Results are tabulated. All treatments sufficed against scab, the controls showing 44% of scabbed fruit. The spray injury was smallest following treatment II, viz. lime-sulphur 2 : 100 at pink bud stage, and at calyx stage, bordeaux $\frac{1}{2}$: 1 : 100 three weeks after calyx spray, and again six weeks after calyx spray, and greatest after treatment IV, viz. bordeaux at same 4 stages as in II and at same strength. Red spider was practically prevented by lime-sulphur spraying at the pink bud and calyx stages. [From authors' summary.]

348. POLLITT, C. 632.95
Spray plant and materials.
J. Dep. Agric. S. Aust., 1936, 40 : 264-9.

The stated objects of this paper are : (1) To draw attention to some factors which influence greatly the efficiency of the modern spraying plant. (2) To note the composition, characteristics and uses of the important spray materials. (3) To discuss spray combinations, spreaders and adhesives, hard water and spray injury. These aspects of spraying are dealt with simply and concisely.

349. DALLAS, W. K. 632.95

Spray schedule for control of principal orchard diseases and pests.

N.Z. J. Agric., 1937, 54: 15-24.

Notes, accompanied in many cases by a tabulated schedule, are given for the control of all the orchard diseases and pests of any importance in New Zealand.

350. FAJANS, E. AND MARTIN, H. 632.95

The incorporation of direct with protective insecticides and fungicides. II. The effect of spray supplements on the retention and tenacity of protective deposits.

J. Pomol., 1937, 15: 1-24, bibl. 6.

The authors describe the continuation of the work discussed in 1935 (*Ibidem*, 13: 261-92, bibl. 33; *H.A.*, 1936, 6: 82). In the previous article laboratory evaluation of wetting agents was considered. In the present account both laboratory and field trials are described. They are summarized as follows:—"1. The physical properties of spray deposits affecting the efficiency of protective insecticides and fungicides are discussed. The quantity of spray residue is determined by the initial amount deposited upon the sprayed surface (initial retention) and the ability of the deposit to withstand the action of the various agencies tending to its removal (tenacity). In addition, qualities of the spray deposit such as the uniformity of deposition (coverage) are concerned in relation to their effect upon the action of solubilizing agencies (availability) and upon tenacity. 2. The initial retention of the solid particles of the suspensions examined is shown to be that of the aqueous phase, an indication that no preferential retention of the solid occurs. 3. In the majority of the systems examined, the initial retention of the suspension is the same as that of the aqueous phase but, in a number of cases, the presence of solid particles reduces initial retention. This phenomenon appears to be related to the effect of the solid particles on the wetting and spreading properties of the spray, but it is shown not to be independent of the nature of the surface sprayed. 4. The tenacity of the spray deposit is dependent upon the characters of the spray supplement, of the solid particle and of the surface sprayed. As a general rule, the degree of tenacity is determined by the relative ease of wetting of the spray deposit and, in accordance with this hypothesis, (i) tenacity is comparatively higher upon surfaces wetted with difficulty, (ii) supplements yielding residues insoluble in cold water, e.g. gelatine and lime casein, exert a favourable effect upon tenacity, whereas highly surface-active supplements, especially at high concentrations, exert a deleterious effect upon tenacity, (iii) oils, both hydrocarbon and glyceride, enhance tenacity. 5. The laboratory method for the estimation of initial retention furnishes results in satisfactory agreement with field estimates based upon spray residue determinations. 6. The laboratory estimates permit the arrangement of the spray supplements examined in order of favourable and unfavourable effect upon tenacity. This order is almost identical with that deduced from field trials."

351. COUPAN, —. 632.95

Le traitement par pulvérisations des noyers et, d'une manière générale, des arbres de grande taille. (Spraying walnut and other large trees.)

C.R. Acad. Agric. Fr., 1936, 22: 923-31.

Trials made at Fullin in April and June 1936 proved that the methods in use for spraying large walnut trees 30-40 or even 50 ft. in height are not efficacious. The difficulties are chiefly those of distance and sight and the unwieldy nature of any apparatus capable of delivering adequate spray coverage over the required area. The use of platforms, of telescopic and swivelling lances and the difficulty of propelling very finely divided spray material over long distances are discussed. It is considered that one of the first essentials to success is the provision of clearances in between the trees for the easier and quicker manipulation of the apparatus. Finally the necessity is stressed for providing some form of stirring mechanism to ensure continued uniformity in strength of solution.

352. MARSH, R. W. 632.952.21
Some American work on the copper fungicides.
Sci. Hort., 1937, 5 : 60-5, bibl. 35.

From the American work reviewed in this paper the following conclusions are drawn. In potato spraying with bordeaux mixture, the highest yields have resulted, in the absence of blight, from decreasing the amounts of copper in the successive sprays. The mixture should have a lime content not more than half that of the copper sulphate. On apples, copper phosphate and copper ammonium silicate sprays have promising fungicidal values but are of doubtful safety on foliage and fruit. Cuprous oxide damages leaves of tomatoes, roses and hops less than bordeaux mixture. Cuprous oxide in powder form shows considerable possibilities as a seed dressing for the control of damping off and seedling rots.

353. KEARNS, H. G. H. AND OTHERS. 632.753 : 632.952
Investigations on egg-killing washes. II. The ovicidal properties of hydrocarbon oils on *Aphis pomi* De Geer.
J. Pomol., 1937, 15 : 56-67, bibl. 10.

1. A laboratory method for comparing ovicidal properties, employing eggs of *Aphis pomi* De Geer as test material, is described. By this method it has been shown that :—2. Ovicidal properties to *A. pomi* of hydrocarbon oils are determined by their content of high-boiling neutral oils soluble in dimethyl sulphate. There is no evidence of large differences in the ovicidal properties of high-boiling neutral oils soluble in dimethyl sulphate derived from various sources. [Authors' summary.]

354. GREEN, J. R. 581.12 : 632.95 : 634.11 + 635.65
Effect of petroleum oils on the respiration of bean plants, apple twigs and leaves, and barley seedlings.
Plant Physiol., 1936, 11 : 101-13, bibl. 9.

The horticultural material consisted of young bean plants cut off at ground level when 8-12 in. high, apple twigs, 12 in. long, bearing leaves, the spraying being done in the field, and similar twigs on which the spraying was done in the laboratory. The technique and dosage of spraying and the method of measuring respiration are all detailed. The author in summarizing makes the following observations :—(1) The averages of several tests with plants sprayed with poorly refined oils show that the rate of respiration was increased, but individual determinations show that in some cases respiration was retarded. (2) The averages with highly refined oils show an increase in rate of respiration, but to a smaller extent than with poorly refined oils. Again individual determinations show that highly refined oils may also retard respiration. (3) The changes caused by oils in the rate of respiration extend over long periods.

355. JONES, H. A. 632.951
The optical rotatory power of extracts of derris and cube roots.
J. agric. Res., 1936, 53 : 831-9, bibl. 12.

Values for "rotenone" equivalent to the combined optical rotatory powers of both acetone and benzene extracts of derris and cube roots gave an approximate measure of the insecticidal effectiveness of these materials to house flies. Values calculated from the rotation of benzene extracts did not agree with toxicity so well as did the combined values, and in about half the samples results derived from the optical activity of acetone extracts were widely different from the toxicity values. Since a method has already been proposed for calculating the approximate toxic value to house flies of derris and cube roots based on the rotenone and total extractive contents, which is both simpler and less open to question, the use of optical rotatory power cannot be recommended as a means of evaluation. From the chemical standpoint the results indicate that optically active constituents other than rotenone and deguelin were probably present in the samples of derris and cube tested. Dextrorotatory materials were undoubtedly

present in the samples of derris root containing no rotenone, and possibly in other samples. The use of optical rotation should prove of considerable value in further chemical study of the components of extracts of derris and cube roots. [Author's summary and conclusions.]

356. LE PELLEY, R. H. AND SULLIVAN, W. N. 632.951.1

Toxicity of rotenone and pyrethrins, alone and in combination.

J. econ. Ent., 1936, 29 : 791-7, bibl. 7.

Alcoholic solutions of pyrethrins and of rotenone and mixtures of these solutions were tested against house flies by a turntable method. Rotenone was from five to six times as effective as pyrethrins containing pyrethrin I and II in equal proportions, when mortality counts were made at the end of three days after treatment. No striking synergistic effect was produced by 50 : 50 mixtures of these solutions, but they appeared to be significantly more effective than expected. It was doubtful whether the 25 (rotenone) : 75 (pyrethrins) mixtures were more effective than expected. As the results showed that mixtures of rotenone and pyrethrins are compatible, attention was given to sources of rotenone-like insecticides for mixing with pyrethrum extracts for the control of coffee insects in Kenya. A few tests were made of acetone extracts of the leaves, roots and stems of a sample of *Cracca Vogelii* received from Kenya. The effectiveness of these parts decreased in the order named. The extract of the leaves, which contain the largest proportion of toxic materials, exerted an effect equivalent to a rotenone content in the plant material of about 2%. [Authors' summary.]

357. WISECUP, C. B. 632.651.1

Decrease in effectiveness of stored pyrethrum dusts as shown by biological tests with the celery leaf tier in the laboratory.

J. econ. Ent., 1936, 29 : 1,000-3.

The tests, which were carried out in Florida, indicate that undiluted pyrethrum dust retains its effectiveness when stored for as long as three years in closed containers and that the commonly used pyrethrum-tobacco mixture should remain effective in similar containers for 1 or 2 years. It has been shown, however, that the mixture deteriorates when stored in open containers.

358. WILCOXON, F. 632.951.1

The determination of pyrethrin I.

Contr. Boyce Thompson Inst., 1936, 8 : 175-81, bibl. 13.

Chrysanthemum monocarboxylic acid has been isolated from a pyrethrin concentrate and its properties described. Samples of the purified acid submitted to steam distillation as in the Seil method for pyrethrin I failed to give quantitative recovery of the acid. When the same sample was repeatedly steam distilled a loss of the acid was demonstrated at each distillation. The reaction of the monocarboxylic acid with Denigrés' reagent was studied quantitatively by applying the iodate titration method of Jamieson to the reduced mercury. It was found that three atoms of mercury are reduced per molecule of mono-acid. Examination of the steam distilled acid from a pyrethrin concentrate showed that it is contaminated by other acids which are included in the titration by the Seil method. The net effect of these two sources of error is to cause the Seil method for pyrethrin I to give lower results than the true value. The reaction of the monocarboxylic acid with Denigrés' reagent has been adapted to the quantitative determinations of pyrethrin I in flowers and extracts, and examples of the application of this method are given. [Author's summary.]

359. HARTZELL, A. AND WILCOXON, F. 632.951.1

Relative toxicity of pyrethrins I and II to insects.

Contr. Boyce Thompson Inst., 1936, 8 : 183-8, bibl. 15.

A partial separation of pyrethrins I and II was effected by multiple extraction using as solvents petroleum ether and aqueous acetic acid. Extracts were obtained in which the ratio of I to II varied from 4 to 0.047 according to the Seil method of analysis. The comparative toxicity of pyrethrum extracts varying in ratio of pyrethrins I and II was determined on *Aphis rumicis*

using acetone and a miscible oil as solvents for the pyrethrins with water. When extracts high in pyrethrin I were compared with extracts high in pyrethrin II using acetone as a solvent, the pyrethrin I extracts were considerably more toxic than extracts high in pyrethrum II. When a miscible oil such as Penetrol was used as a solvent the difference in toxicity tended to disappear. When similar extracts were tested on house flies (*Musca domestica*) by means of both the Peet-Grady method and a modified Nelson method, the differences obtained in the toxicity of extracts high in pyrethrin I and extracts high in pyrethrin II were not statistically significant. The results indicate that the physical condition of the pyrethrins at the time of application is a determining factor in the relative toxicity at least so far as *Aphis rumicis* and *Musca domestica* are concerned. The relative toxicity of pyrethrins I and II depends almost entirely upon the method of application used. [Authors' summary.]

360. BALACHOWSKY, A. 632.754
Note préliminaire sur les dégâts occasionnés par *Tettigoniella viridis*. L.
aux cultures fruitières du marais niortais. (A preliminary note on the damage
done to fruit trees by *T. viridis* in the Niort marshes.)
C. R. Acad. Agric. Fr., 1936, 22 : 1,057-64.

In Italy and previously in France this jassid insect had not been considered as harmful, but examinations made in the neighbourhood of Niort disclosed the fact that of recent years considerable damage has been done by it to apples, pears, quinces, loquats, apricots, roses, currants, gooseberries, raspberries and other berries of the *Rubus* family. The damage is done by egg laying incisions which are made on low lying branches or on stems 1-3 years old. It is said to be very serious not only as checking the growth of the tree but also as causing the young shoots to dry out and die. As the insect moves neither by flight nor hops, banding with some sticky material is advocated at 30 cm. above ground level, and, as it spends the night in grass beneath the trees, the spread of insecticides over this area commends itself for trial.

361. MUNDINGER, F. G. 632.77 : 634.13
Pear midge in relation to fruit set and timing of control sprays.
J. econ. Ent., 1936, 29 : 1,058-63.

Investigations in New York State during 1931-3 have shown that, when one or more Bartlett pear fruits in a cluster are infested by the pear midge, *Contarinia pyrivora* Riley, most of the other uninfested fruits in the same cluster are liable to be shed. The reason for this is unknown. The midges were found to oviposit commonly in the four most distal blossom buds on the peduncle, whereas the blossom buds most likely to set and mature fruits are normally those nearest the base of the peduncle. It is, therefore, concluded that control sprays timed to destroy the midges before they are able to oviposit in any of the four most advanced blossom buds will afford the best protection against the pest.

362. STEINER, L. F. AND ACKERMAN, A. J. 632.78 : 634.1/2
Large-scale or orchard sanitation to control codling moth. Progress report.
J. econ. Ent., 1936, 29 : 648-53, bibl. 3.

An experiment was started in Indiana in April 1934 to obtain more exact information as to the effect of orchard sanitation in controlling codling moth. A 40-acre orchard, consisting almost entirely of 31-year-old trees of the varieties Ben Davis and Collins set in alternate rows, was divided into two equal parts. In one part all surface debris, such as leaves, bark and weeds, and all dead or split wood and rough bark were removed, and chemically treated bands were applied to the trees. The other part of the orchard was left as the control. In addition both areas were sprayed with lead arsenate according to the same schedule. The sanitary measures resulted in yield increases over the uncleaned block of 59% in 1934 and 19% in 1935, due mainly, it is thought, to a reduction in the injury caused by the apple flea weevil, *Orchestes pallicornis*, and by scab. Codling moth infestation records were secured from 74 trees in 1934 and 80 trees in 1935. They showed that in 1934 the cleaning operations reduced the number of larval entrances by 41.9% per 100 apples and by 13.5% per tree. The average reductions

in 1935 were 57.1% per 100 apples and 45.1% per tree. In 1934 the bands caught 91,000 larvae, which is about 10% of the total number that entered fruits in the area, but is certainly a much higher percentage of those which would normally have remained in the orchard and completed their life cycle.

363. MILES, M.

634.11-2.78

The apple pith moth.*J. Minist. Agric., Lond.*, 1937, **44** : 138-42.

This moth (*Chrysochista atra* Haw.) has caused damage recently in the South and East of England. Leaves of infested shoots tunnelled by the larvae wilt, shrivel and turn brown, while the blossoms die before opening or the fruit cluster just after setting. The damaged shoots and spurs are very conspicuous. Possible control measures are hand picking of infested shoots and light trapping. Spraying is ineffective. The insect is extensively parasitized. The suggestion is made that infested shoots should be kept in gauze covered boxes through which the small parasites could escape while the larger ones could be separated, since they are active in the sunlight while the moths are quiescent.

364. STRICKLAND, A. G.

632.95 : 634.11 + 634.13

The removal of spray residue from apples and pears.*J. Dep. Agric. S. Aust.*, 1936, **40** : 411-7.

In hand washing experiments during the 1935-6 season 1% hydrochloric acid solution proved more effective than 8% sodium silicate solution in removing arsenical residues from Cleopatra and Jonathan apples, which had been sprayed according to several schedules with lead arsenate plus or minus oil. The effect of washing treatment on keeping quality was also studied, and it was found that neither of the above washing solutions had any adverse effect on Jonathan apples held in cool storage. In the case of Cleopatra, a variety with an open calyx tube, however, a proportion of the fruits immersed to 12-14 in. in the acid solution were subsequently attacked by moulds, principally of the mouldy core type, whereas fruit immersed to a depth not exceeding 6 in. showed much smaller losses. Recommendations based on these results are made for the removal of the residues from apples and pears with hand-washing equipment, and a diagram is given showing a system of acid and rinse dipping troughs.

365. MILLER, D., CLARK, A. F. AND DUMBLETON, L. J.

632.96

Biological control of noxious insects and weeds in New Zealand.*N.Z. J. Sci. Tech.*, 1937, **18** : 579-93.

A symposium of 5 pages presented at the 5th Science Congress of the Royal Society of Dunedin, 1935, the first named author being responsible for 3 and the others for 1 each. Four weeds, blackberry, piri-piri (*Acaena* spp.), ragwort and gorse have been attacked by methods of biological control. The blackberry proved unassailable, chiefly because the parasites attacking it turned with equal or greater zest to the defoliation of orchard fruit trees. Definite success has been obtained in the case of gorse and promising results on the other two. Seven pests of exotic forest trees and the biological control experiments in connexion with them are discussed. In the case of orchard pests attempts have been made to introduce 37 insect parasites or predators to control about 12 pests, and of these 11 are known to be established.

VEGETABLE GROWING,* FIBRES, STIMULANTS.

366. FRISCHENSCHLAGER, B.

635.1/7 : 631.531

Versuche über die Keimstimmung an einigen Gemüsearten. (Effects of various treatments on the growth of vegetable seedlings.)*Gartenbauwiss.*, 1937, **11** : 159-66, bibl. 6.

(1) Immediately after germination very young seedlings of cauliflower, kohlrabi, tomato and peas were submitted in complete darkness for 14 days to temperatures of -4°C . [This merely

* See also 352, 354, 357.

killed the plants and was tried only with cauliflowers.—Ed.], -1°C. and $+2^{\circ}\text{C.}$, after which they were removed to pots and cultivated normally. (2) Seed was sown in pots and the germinating seedlings were grown for the first 14 days under lighting conditions corresponding to shortened daylight, normal daylight and normal daylight plus artificial lighting, afterwards receiving normal cultivation. (a) Cauliflower. Cold treatment induced frost resistance, but artificial lighting resulted in great susceptibility to frost and imperfect heads. (b) Tomatoes. Cold treatment and decreased daylight resulted in a decreased crop, while artificial lighting induced increased cropping. (c) Kohlrabi. Cold treatment at 2°C. led to an increased crop. Artificial lighting induced luxuriant growth especially in the leaves. (d) Peas. These grew more strongly after cold treatment at 2°C.

367. STEER, W. L.

635.1/7: 631.8

Manurial experiments on vegetable crops in Lancashire.*Sci. Hort.*, 1937, 5: 34-8.

The trials were carried out from time to time under the supervision of the County Council instructors. *Celery*. The usual 20 ton per acre dressing of farmyard manure was profitably replaced by a 15 ton dressing + 4 cwt. superphosphate, $+1\frac{1}{2}$ cwt. sulphate of potash, + 1 cwt. sulphate of ammonia or 1 cwt. nitrate of soda, the nitrate being given as a top dressing during the growing season. The nitrogenous dressings appreciably increased the weight of the bundles and proved more profitable than basic dressings alone. Added to 20 ton dressings of farmyard manure substantial dressings of artificials were unprofitable. *Beetroot*. 1 cwt. per acre of sulphate of ammonia or nitrate of soda profitably increased total yields and size of roots, the former dressing dug in with the manure being best in dry seasons, while nitrate of soda was better as a top dressing in heavy land in a wet season when early growth was poor. *Carrots*. An additional nitrogenous top dressing applied in July to an April sown crop increased the yield by 1 ton per acre. Carrot fly caused damage only to plants growing in bands of silt occurring occasionally in a sandy soil. *Potatoes*. Trials were carried out in 1933 (Kerr's Pink) and 1934 (Majestic) to test the value of farmyard manure versus shoddy and artificials. The added artificials were per acre 4 cwt. superphosphate, 2 cwt. sulphate of potash. A significant result in favour of farmyard manure over best shoddy was obtained in 1934 but not in 1933 which was a dry season. Short shoddy showed a superiority over best shoddy, possibly due to the unexpectedly high nitrogen content of the former. Short shoddy is also easier to handle. The opinion is expressed that expenses could be reduced without detriment to the returns by the substitution of wool shoddy ploughed in during the winter for some of the crops in the rotation.

368. MUCKENHIRN, R. J.

631.811.9

Response of plants to boron, copper, and manganese.*J. Amer. Soc. Agron.*, 1936, 28: 824-42, bibl. 38.

Studies on the influences of boron on lettuce grown in quartz sand cultures and of copper, manganese and zinc on potatoes and onions grown in peat soils are reported. *Effect of boron on lettuce*. It was found that lettuce in sand cultures was unable to continue normal growth or produce a second growth of leaves unless boron was added. In boron-deficient plants the growing point became deformed and later died, while the leaves showed characteristic thickening, crumpling and curling. Such plants resumed normal growth after the application of boron. The dry leaves of plants to which boric acid had been applied from the beginning of the trial contained about 20 p.p.m. of boron, whereas the first leaves of the boron-deficient plants contained about 10 p.p.m. Pyrex glass and Milorganite (an activated sludge) also proved good sources of boron, although where the latter was used alone mild symptoms of boron deficiency developed. *Effect of copper, manganese and zinc on onions and potatoes*. Applications of manganese and copper produced significant increases in total weights of onion plants growing on peat soil in pot cultures, but zinc had no significant effect. There was some evidence to suggest that copper and manganese affected the relative growth of the bulbs and tops and the maturation of the plants as well as the rate of growth, while copper also appeared to improve considerably the quality of onion bulbs grown on peat in the field. All three elements applied

to potatoes growing on peat in the field increased yields, and copper again appeared to improve the quality of the tubers. Studies on the effect of kaolin on the growth and manganese content of buckwheat and the effect of copper, manganese and zinc on the growth of sweet clover are also reported.

369. MOORE, H. I. AND JONES, A. P. 631.811.9 : 546.72
Iron and plant growth.
Gairns' Chron., 1936, 99 : 199-200.

Applications of ferrous sulphate at rates of $\frac{1}{2}$, 1 and 2 cwt. per acre did not produce any significant increases in the yields of potatoes growing in three Yorkshire soils containing, on the average 1.18%, 2.40% and 5.84% of iron oxide, respectively, and different amounts of lime. In every case, however, the leaves of the plants from the treated plots were a richer, deeper green, and, although the evidence on this point is not conclusive, appeared to be healthier and more resistant to disease.

370. MACK, W. B. AND BRASHER, E. P. 631.8 : 635.1/7 : 581.192
The influence of commercial fertilizers, potassium iodide, and soil acidity on the iodine content of certain vegetables.
J. agric. Res., 1936, 53 : 789-800, bibl. 42.

Various amounts of nitrate of soda, superphosphate, and muriate of potash were applied in 1931 to potatoes, tomatoes and sweet corn, growing in plots at the Pennsylvania State College, which had received similar annual fertilizer treatments since 1917. Yields, soil acidity in terms of pH, and the iodine content of the crop were measured, but no relationship was found between the iodine content and either the fertilizer treatment, the soil acidity or the yield of the crop. The effect of applying potassium iodide at a rate of 2.356 kg. per acre, supplying approximately 2.0 mg. iodine per kilogram of soil in the upper 6 inches, was also studied in 1931 on beans (*Phaseolus vulgaris* L.) and turnips. The treatment increased the iodine content of the green pods of beans considerably, though to less than three-fold in all cases, but reduced yields markedly through injury to the plants. With turnips the application of potassium iodide stimulated growth and increased yields slightly, while the iodine content of the whole plants was increased from 10- to 120-fold on different plots. The greatest increases in iodine content of turnips occurred on plots made alkaline with hydrated lime, and the smallest increases on plots made acid with sulphur or left unmodified by either lime or sulphur. Similarly, the iodine content of turnips from plots receiving no potassium iodide was generally greater, the more acid the soil. Beans, however, showed no consistent relationship between soil acidity and iodine content on the untreated plots. The application of potassium iodide was found to have no residual effect when the plots were planted in the same way the following year, but without additional iodine.

371. VAN SCHREVEN, D. A. 633.63-2.19
Copper deficiency in sugar beets.
Phytopathology, 1936, 26 : 1,106-17, bibl. 47.

The symptoms of copper deficiency in sugar beets were studied at Bergen op Zoom, Holland, during the summer of 1935. The plants were grown in water cultures, half receiving no copper and the other half 0.5 mg. $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ per litre. The beets receiving no copper exhibited some chlorosis after 19 days, and this increased gradually in intensity. The symptoms were most marked in the older leaves and in those half way up the plants, while the heart leaves remained normal. The chlorotic parts of the older leaves died after about 2 months, becoming grey-brown to grey or white in colour. The beets were harvested in September, and, although there was little difference in the weight of foliage between plus- and minus-copper plants,

there were highly significant differences in favour of the plants which had received copper between average weights of roots and average sugar contents. In discussing his results the author draws attention to the similarity between the early symptoms of copper deficiency and of the "black wood-vessel disease" as described by other authorities. The latter is caused by a species of *Pythium*, and in it the chlorosis is usually followed by withering of the outer leaves, a manifestation which was not apparent in the copper-deficient plants. Comparisons are also made between the symptoms of manganese deficiency and copper deficiency. The principal points of difference between the two would appear to be:—(1) The shading of the marbling is finer in copper-deficient plants, (2) manganese-deficient plants generally impress the observer as being yellower, and (3) in manganese-deficient plants the leaves are generally more markedly curled upwards.

372. BUTLER, O. 633.491
Variations in yield of pure line Green Mountain potatoes grown in a controlled environment.

J. Amer. Soc. Agron., 1936, 28 : 706-10.

The experiments described here were undertaken to test the theory that certain pure lines of a healthy stock are more productive than others and that selection from such pure lines is therefore advisable. Potato yields were tested over several generations both from pure lines and from ordinary good healthy stock and the conclusion is reached that it is wasted labour to select seed from healthy stock on the basis of yield and tuber number. All that is necessary to maintain productivity is selection from healthy hills of uniformly vigorous plants.

373. WHITEHEAD, T. 633.491-2.8
The virus problem in relation to seed potato production in North Wales.
Sci. Hort., 1937, 5 : 39-46.
 DAVIES, W. M. (the late) 633.491-2.753
Aphis migration and distribution in relation to seed production.
Ibidem, 5 : 47-54, bibl. 10.

The first paper reports a field survey in North Wales in search of localities in which a virus disease of potato was absent or slowed down. Tests were also made, in vain, in the hope of finding immune market varieties. The ultimate relation existing between virus infection and degeneration was proved by statistical comparison of yields of stocks infected with virus to different degrees. Immature seed from a district of rapid degeneration yielded much better and healthier crops than mature seed, but in a district in which there was little virus the yields were no better than from seed lifted at the normal time. As a result of the survey the North Wales potato scheme for producing seed of high quality in certain districts was initiated and has proved successful owing to the meticulous care with which the sanitary conditions have been observed. The working of the scheme is briefly described, as is the future policy with regard to potato crop improvement. Current investigations are concerned with the reasons for the success of some farms and the failure of others. The distribution of the insect vector, *Myzus persicae*, is a main factor. It is this very interesting problem which forms the subject of the second paper.

374. ZIMMERMAN, P. W. AND HITCHCOCK, A. E. 635.24 : 612.014.44
Tuberization of artichokes regulated by capping stem tips with black cloth.
Contr. Boyce Thompson Inst., 1936, 8 : 311-5, bibl. 4.

Jerusalem artichokes grown in pots under normal summer day length conditions produced long slender underground stems (rhizomes), but no tubers. Plants similarly grown, but completely covered with a black cloth from 4.30 p.m. to 9 a.m., or with their stem tips capped with black cloth during the same period, produced no underground stems, but formed tubers. This

result indicates that capping the stem tip has the same effect on the formation of rhizomes and tubers as covering the whole plant to provide a short day. It is therefore concluded that the controlling influence is centred in the growing tip rather than in the plant as a whole. The information obtained also indicates that there is a correlation between rate of stem elongation and the form of development of underground parts. With medium day length the rate of elongation was slightly retarded; with very short days it was greatly retarded. The question arises from this as to whether factors other than light which affect rate of stem elongation might also influence the formation of rhizomes and tubers. Experiments with synthetic growth substances, which are known to retard stem elongation, are now in progress in an attempt to elucidate this question.

375. GAUT, R. C. 635.31
Asparagus trials in Worcestershire. Male v. female.
Fruitgrower, 1936, 81: 996.

In an experiment carried out in Worcestershire male asparagus plants produced, in each of the three years 1933 to 1935 inclusive, about twice as many buds as did female plants. The difference in favour of the male plants was most marked during the first 11 days of cutting in 1936 (the fourth year of the trial), when the comparable figures, expressed in terms of bundles of best (120 heads) per acre, were female 17½ bundles, male 139 bundles.

376. THORNTON, N. C. 635.52: 631.521.5
Carbon dioxide storage. IX. Germination of lettuce seeds at high temperatures in both light and darkness.
Contr. Boyce Thompson Inst., 1936, 8: 25-40, bibl. 9.

Seed of both black and white seeded lettuce was used for the experiments described here. The technique of exposure to different conditions of light and atmosphere is detailed. The discovery that germination can be induced by CO₂ treatment is in contrast to Kidd's results some years ago when he obtained the inhibition of germination of seeds of barley, pea, bean, cabbage, onion and white mustard by exposing them to CO₂. It is concluded that Kidd's finding of an inhibitive effect of CO₂ is not of general application. The following notes are from the author's summary:—Hitherto temperatures below 20° C. in darkness and below 26° C. in light have been considered necessary for good germination of recently harvested lettuce seed. These experiments show good germination resulting even at 35° in light or darkness in the presence of CO₂. At 20° to 26° C. from 5 to 20% CO₂ with 20% O₂ bring about germination within 17 hours. Higher temperatures (35° C.) demand higher percentages of CO₂ and longer exposure to CO₂. Seed made dormant by moist storage at 35° C. without CO₂ will germinate at 35° C. during and after exposure to 40-80% CO₂ and 20% O₂ for 96 hours. Seedlings forced to germinate by exposure to CO₂ grow well on transfer to air.

377. JONES, H. A. AND EMSWELLER, S. L. 635.25: 581.145.1
Development of the flower and macrogametophyte of *Allium Cepa*.
Hilgardia, 1936, 10: 415-28, bibl. 9.

The outer perianth whorl and the outer stamen whorl are the first floral organs to differentiate in the onion. These are followed by the inner perianth whorl and inner stamens, and lastly by the carpels. The outer perianth segments and their subtended anthers usually arise counter-clockwise. The sequence of development of the members of the inner whorls of perianth and anthers is usually clockwise. The first segments of the inner whorls usually arise between the oldest and second oldest segments of the outer whorls. The embryo is formed from the chalazal daughter cell. One of the synergids is distinctly hypertrophied; both appear to be well supplied with reserve food. [Authors' summary.] [Illustrations are numerous.—ED.]

378. ESAU, K. 635.53 : 581.144.1
Ontogeny and structure of collenchyma and of vascular tissues in celery petioles and Vessel development in celery.

Hilgardia, 1936, 10 : 431-76, bibl. 21, and 479-88, bibl. 5.

Efforts to obtain stringless varieties of celery drew attention to the nature of the so-called "celery strings". The first paper deals with the ontogeny and structure of the two tissues which constitute these strings, namely, the vascular bundles and the collenchyma strands, which are shown to differ greatly from each other in their development, histology and relative strength. The mode of origin of the collenchyma strands is compared with that of the vascular tissue, and a detailed description is given of the phloem and its transformation, in the final stages, into the collenchymatous bundle cap. The text is accompanied by numerous figures and plates. The second paper reports observations, made incidentally to the first anatomical study, on vessel end walls in celery petioles. The circumstances prompting the writer to make these observations were the comparative lack of information, and surprising lack of agreement in available descriptions, with regard to the sequence of events in the establishment of continuity between vessel elements. As in the first article, the text is illustrated with a number of plates and diagrams.

379. EMERY, H. AND PRAT, H. 635.62 : 581.4
 Sur un cas de fascie héréditaire chez *Cucurbita Pepo*. (A case of hereditary fasciation in pumpkins.)

Bull. Soc. nat. Hort. Fr., 1936, 3 : 159-60, bibl. 21.

A case of fasciation has been found in a pumpkin called *Bonnet turc* (a progeny of *Giraumon Turban*), which was growing among five other normal plants. Seed from the plants had in eight preceding generations given rise to normal plants, but seed from the fasciated plant gave rise to individuals all of which reproduced the abnormality of the parent in three succeeding years. The characteristics of the fasciated individuals are described. Observations are to be continued to determine what relationship, if any, exists between the abnormality and malformations of the embryo, the possible presence of a virus or soil conditions.

380. TILGNER, D. J. 664.84.63 : 635.63
Quality requirements for canning cucumbers.
Food Manuf., 1936, 11 : 401-2, bibl. 4.

The characters contributing to, or detracting from, desirable quality in cucumbers for canning are discussed briefly with particular reference to standards and varieties established in Poland. In order to eliminate unsuitable types, the eradication of all weak and off-type plants in fields of seed cucumbers is advocated. Finally it is noted that the firmness of the canned cucumbers appears to depend primarily upon the pectin content of the raw fruit, which varies both with variety and the age of the cucumber.

381. SCARPITTI, G. 635.64
Criteria for identification of good varieties of tomatoes.

Int. Rev. Agric. (Mon. Bull. agric. Sci. Pract.), 1936, 27 : T.81-T.89.

Experiments and observations in Italy show that the most exact criterion of comparison between different varieties of the same fruit is afforded by the ratios between the sugars and the organic acids in their fruits during the ripening cycle. A comparison of these ratios in the case of ripe fruit of 43 Italian, French and English tomato varieties shows that those with a sugar : organic acids ratio of about 10 : 1 are much more suitable both for export and for preserving than those with a lower ratio. It is suggested that a determination of this ratio in the ripe fruits should facilitate selection of varieties suitable for growing in any one place. Further, as regards the sampling of preserved tomato, although the amount of total dry residue and the degree of purity as assessed by the Howard method are important, the sugars : organic acid ratio is even more important as a test of the flavour and aroma which are the essential features of canned tomatoes.

382. DASKALOFF, C. 635.64 : 575
 Beitrag zum Studium der Heterosis bei den Tomaten in Bezug auf die Herstellung von Heterosis-Sorten für die Praxis. (**A study of heterosis* in tomato and its bearing on the production of commercial heterosis strains.**)
Gartenbauwiss., 1937, 11 : 129-43, bibl. 5.

The experiments described here were carried out at the Philippopol Research Station in Bulgaria in the years 1934-6. The following notes are taken from the author's summary. Heterosis effect was found in the F_1 generation of all tomato crosses investigated, being chiefly noticeable in increased crop. This increase varied from 5.5 to 37.2%. As regards precocity of ripening the F_1 generation was either intermediate or superior to both parents. The heterosis effect was even more noticeable in early stages of growth than in the later ones. The effect was not affected by the direction of the cross. There was an average falling off in the crop of the F_2 generation (3 crosses) as compared with that of the F_1 of 5%.

383. C., R.C. 635.64
A haploid Marglobe tomato.
J. Hered., 1936, 27 : 433-5.

This is a brief discussion of Morrison's success at the Ferry-Morse Seed Breeding Institute, Rochester, Michigan, in producing an absolutely uniform strain of the valuable Marglobe tomato, by the discovery and use of a haploid "mutant".

384. MITCHELL, J. W. 635.64 : 631.588.2
Effects of carbon arc light on the chemical composition and vegetative propagation of tomato plants grown with a limited supply of nitrogen.
Plant. Physiol., 1936, 11 : 833-41, bibl. 12.

Exposure to carbon arc light for 12 hours daily resulted during a 10 day period in a 400% increase in carbohydrate content of the above-ground portion of young tomato plants grown in a nitrogen free nutrient. Moreover, if plants were exposed to arc light previously, there was an increase in the production and root growth of cuttings taken from those plants and grown in natural light of low intensity. Such cuttings were, moreover, less subject to decay than those taken from plants grown in natural daylight of low intensity during winter without further illumination. [From author's summary.]

385. YOUSEN, W. J. AND ZIMMERMAN, P. W. 631.53 : 635.64
Field trials with fibre pots.
Contr. Boyce Thompson Inst., 1936, 8 : 317-31, bibl. 8.

Preliminary trials in 1932 indicated that eggplant, tomato, pepper and cabbage plants started in 10 different types of fibre pot produced higher yields than plants started in flats (seed boxes), but that there were no consistent differences in favour of any particular type of pot. In 1933 comparisons were made between two tomato varieties, Bonny Best and Marglobe, started in seed boxes, paper (wood cellulose), clay and fibre pots, and fibre pots which had been soaked in 1% sodium nitrate solution. In each case comparisons were also made between 3 in. and 4 in. pots and between 80 and 40 plants grown per flat. The containers were filled either with field soil or with field soil plus a 4-8-7 fertilizer in the proportion 1 : 100. The plants were subsequently planted out in the field in a split block, latin square lay out and the effects of the 40 treatments on yields compared statistically. The fibre pots soaked in nitrate produced the highest yields, being followed in order of decreasing yield by clay pots, fibre pots, flats and paper pots. The plants grown in pots were approximately 10 days earlier than the plants grown in flats. Thus, although yield curves showed Bonny Best to be earlier than Marglobe, plants of the latter grown in pots produced earlier yields than did plants of Bonny Best grown in flats. Differences in yields of plants grown in 3 in. and 4 in. pots only amounted to about

* The diverse effects following a cross between heterozygous elements.

6% in favour of the larger pots. Lastly, the addition of the complete fertilizer to the soil in the containers would appear from a table given to have increased yields considerably in all cases except those of plants grown in the fibre pots soaked in nitrate. The effect of fertilizer in raising the yields of the plants grown in paper pots was particularly marked.

386. HOWLETT, F. S. 635.64 : 631.8 : 581.192
The effect of carbohydrate and of nitrogen deficiency upon microsporogenesis and the development of the male gametophyte in the tomato, *Lycopersicon esculentum* Mill.
Ann. Bot., Lond., 1936, 50 : 767-803, bibl. 70.

The work described here was carried out mainly at the John Innes Horticultural Institution. The carbohydrate and nitrogen contents of the plants were altered by varying day lengths and by supplemental illumination. Carbohydrate deficiency was found to result in the suppression of the male organs and the production of microspore degeneration and pollen sterility in *L. esculentum*. Nitrogen deficiency in these experiments had little effect on microsporogenesis and the development of the male gametophyte.

387. FOSTER, A. C. AND TATMAN, E. C. 635.64 : 631.432 + 631.8
The influence of soil moisture and fertilizers on the specific electrical conductivity of tomato plant sap.
Amer. J. Bot., 1937, 24 : 35-9, bibl. 4.

The data presented here were obtained in the course of a study, carried out at Arlington Experiment Farm, Rosslyn, Virginia, during 1931 and 1932, on the relation of soil moisture and fertilizer to the occurrence of certain non-parasitic diseases of tomatoes. The object of the present paper is to show the influence of soil moisture at approximately controlled levels and of different fertilizer treatments on the growth response of tomato plants and on the specific electrical conductivity of the plant sap associated with that response. The plants were grown singly in 3-gallon glazed crocks in a good type of greenhouse soil. Eight different combinations of nitrate of soda, superphosphate and sulphate of potash were incorporated in the soil at a rate of 2 tons per acre. The plants were grown at 4 different moisture levels, viz. 39, 47, 56 and 62% of the water-holding capacity of the soil. The technique used in the determination of the electrical conductivity of expressed sap obtained from leaf and fruit samples is described. The authors summarize their results as follows:—"There appears to be a highly significant relation between the fertilizer materials and the water in the soil, the amount of water used daily by the plants, and the ultimate water requirement of the plants. Among cultures grown at different soil moisture contents there occurred a positive correlation between the electrical resistance of the plant sap and the soil moisture. Furthermore, a sudden increase in the soil moisture caused a corresponding increase in the electrical resistance in the sap taken from leaves, green fruit, and ripe fruit of an individual plant. Successively larger amounts of soil nitrates in different cultures were reflected by correspondingly higher electrolytes in the plant sap as indicated by a lower electrical resistance. Potassium sulphate appeared to have a similar influence. However, the different fertilizer treatments used did not influence the electrical resistance of the plant sap so greatly as did the soil moistures employed."

388. GUSTAFSON, F. G. AND STOLDT, E. 635.64 : 581.144/145
Some relations between leaf area and fruit size in tomatoes.
Plant Physiol., 1936, 11 : 445-51, bibl. 14.

The authors describe briefly experiments carried out in 1932, 1933 and 1935. Results show that fruit size can be increased considerably by increasing the food producing area, although not proportionately. The fact that the increase in size is not proportionate to the increase in nutritional area shows that factors other than nutrition at the time of enlargement affect the ultimate size of the fruit. The authors summarize as follows:—(1) The efficiency of the plant, as far as fruit production is concerned, is greatest when the leaf area per fruit is small. (2) By increasing the leaf area the size of the fruit can be increased after the time of setting.

389. KRAUSCHE, K. K. AND GILBERT, B. E. 635.64:1.8
Variations in fleshiness of tomato fruits as affected by fertilization.
Plant Physiol., 1936, 11: 641-5.

The field experiments described here were carried out on Pritchard tomatoes at the Rhode Island Experiment Station in 1935. The following different treatments were applied in triplicate on 1/63 acre plots. Regular fertilizer 5-10-5 at the rate of 1,500 lb. per acre; high and low nitrogen; high and low phosphorus; high and low potash; high and low chemicals, i.e. 2,000 and 1,000 lb. The resulting fruits were examined and it was found that only the nitrogen content produced significant differences in degree of fleshiness, the fruits of high nitrogen plants tending to have relatively less flesh than those of low nitrogen plants. Quality may thus be injured.

390. NEWTON, W. 635.64: 632.8
Virus studies. II. Streak X, a disease of tomatoes caused by a virus of the potato X group unassociated with tobacco mosaic.
Canad. J. Res., 1936, 14, Sec. C., pp. 415-8, bibl. 6.

The author describes transmission experiments made to discover the identity of this newly observed virus disease of tomatoes. The resulting data enable it to be placed in the potato X group of viruses.

391. NEWTON, W. AND EDWARDS, H. I. 635.64: 632.8
Virus studies. III. Tomato diseases.
Canad. J. Res., 1937, 15, Sec. C., pp. 162-7, bibl. 5.

Diseases of tomatoes in commercial glasshouses in British Columbia in 1936 were caused by single virus streak, potato virus X, streak virus X and aucuba mosaic (tobacco virus 6). Of these the commonest was single virus streak and the most dangerous streak virus X. Aucuba mosaic was only noted once, but was highly pathogenic. Mixed virus streak was occasioned by the presence of potato virus X and single virus streak in the same plant. Tomato mosaic (tobacco virus I) was not present. Aucuba mosaic and single virus streak were proved to be distinct, but a distant relationship was found between the latter and tobacco virus I. Three strains of single virus streak distinguishable by symptoms in the plant after inoculation were, however, serologically identical.

392. BERKELEY, G. H. 635.64: 632.8
A strain of the virus which causes streak in tomato.
Canad. J. Res., 1936, 14, Sec. C., pp. 419-24, bibl. 8.

The author describes with the aid of very clear illustrations the symptoms of a strain of tomato streak virus found in Ontario and compares its effects with those of other strains.

393. KODES, H. 635.64: 632.314
Die Anfälligkeit der einzelnen Tomatensorten *Bacterium michiganense* gegenüber und Versuche zur Verhütung der Weitverbreitung dieses Erregers. (Susceptibility of tomato varieties to *B. michiganense* and measures to prevent its spread.)
Gartenbauwiss., 1937, 11: 231-6.

Most of the tomato varieties grown in Germany were found to be susceptible, though in varying degree, to *Bacterium michiganense*, both when inoculated and when growing close to infected plants in the field. The author has found that the infection is carried by the pruning knife

from plant to plant, and he has shown that, if the necessary removal of shoots is carefully done by breaking off instead of cutting, the greatest source of infection is thereby removed. He says that commercial growers in the Palatinate have now adopted this method of shoot pruning.

394. MUSBACH, F. L. AND SELL, O. E. 631.8 : 635.656

Effect of fertilizer on quality and chemical composition of canning peas.

J. agric. Res., 1936, 53 : 869-79, bibl. 27.

Eight fertilizer treatments were applied in 1931 to two canning pea varieties growing on two silt loam soils in Wisconsin. Seven of the plots received 16% P_2O_5 and varying proportions of N and K_2O , the total amount applied being 300 lb. per acre in each case, while the eighth plot received no fertilizer. A properly balanced, complete fertilizer was found to increase the yields of peas and also improve the quality of the canned product as determined on a score card basis. It is suggested that under local conditions such a fertilizer should contain, when applied at a rate of 300 lb. per acre, about 2% N, 16% P_2O_5 and from 4 to 16% K_2O . Chemical analyses were made on the seed coats (skins) of peas from one of the series of fertilizer plots after they had been washed and graded. In three size grades studied, No. 2, No. 3, and No. 4, all fertilizer treatments were found to have increased the phosphorus content of the seed coats, and to have reduced the calcium content, the reductions being most marked when potash was included in the fertilizer. No definite relationship was found, however, between variations in calcium content and the quality of the canned peas. The fertilizer treatments had no consistent effect on the nitrogen and potassium contents of the seed coats. Nitrogen and phosphorus decreased, irrespective of treatment, with advancing maturity, as indicated by size, while calcium increased in every case. No such definite relationship with maturity was found for potassium, which at all stages was present in high concentrations (28 to 38% of the ash). Starch and sugar determinations made on whole peas of No. 3 size grade indicated that variations in quality of the canned peas could not be explained by differences in sugar and starch contents of the fresh peas. It is pointed out, however, that the peas on all the plots were harvested at a relatively early stage of maturity, when they were relatively high in sugar and low in starch, and it is thought probable that variations in quality of canned peas harvested at such comparatively early stages of maturity are governed largely by variations in organic constituents other than sugar and starch.

395. BRONSON, T. E. 632.753 : 635.656

Effect of ground derris upon pea aphid when infesting peas subsequent to spraying.

J. econ. Ent., 1936, 29 : 1,170-2, bibl. 1.

When potted pea plants were sprayed with ground derris root, containing 3.2% rotenone and 13% total extractives at a dilution of 3 lb. per 100 galls. water together with one of two spreaders and wetting agents, and were subsequently infested with nymphs of *Illinoia pisi*, the aphid population declined during the next 7 days to 84% of the original infestation. Derris was in fact found to compare very favourably with nil and with nicotine sulphate treatments. The control effect continued for some 7 days after application.

396. CHAMBERLAIN, E. E. 635.656 : 632.8

Pea-mosaic.

N.Z. J. Agric., 1937, 54 : 129-38, bibl. 3.

Pea-mosaic is prevalent throughout N.Z. on peas and certain other leguminous plants, causing mottling of the foliage, and, in peas, red clover and beans, marked stunting of the plants. The vectors are the aphids *Myzus persicae*, *Aphis rumicis* and *Macrosiphon gei* which convey it from its winter host, red clover, to other plants. Garden pea varieties Lord Chancellor and Little Marvel are immune. Control measures suggested are the use of immune varieties and the planting of susceptible crops as far away as possible from infected red clover.

397. MADEL, W. 632.728 : 631.544
Zur Kenntnis der Lebensweise und praktischen Bedeutung der Gewächshausheuschrecke *Tachycines asynamorus* Adel. (Life history and importance of the greenhouse stone cricket, *T. asynamorus* Adel.)
Gartenbauwiss., 1937, 11 : 85-128, bibl. 45.

The anatomy and life history of this insect are considered in minute detail. It appears to be gradually becoming a more serious pest in hot greenhouses. The chief difficulty of controlling it with ordinary methods is that it requires such strong concentrations of poisonous spray or gas as to endanger plant life. Trapping with inverted flower pots baited with sugary matter would appear to offer the only satisfactory check found as yet.

398. TERRY, G. W. 633.8
Useful garden herbs.
Fmg S. Afr., 1936, 11 : 305.

Brief notes on the propagation and culture of common spearmint, *Mentha viridis*; peppermint, *M. Piperita*; pennyroyal, *M. Pulegium*; thymes, *Thymus vulgaris* and *T. Serpyllum*; and sweet and pot marjoram, *Origanum Majorana* and *O. Onites*.

399. TIBEAU, M. E. 633.525-1.8
Time factor in utilization of mineral nutrients by hemp.
Plant Physiol., 1936, 11 : 731-47, bibl. 10.

These pot experiments in Iowa were concerned with the physiological effects of various nutrients on hemp, *Cannabis sativa*, and the effects of withholding single essential nutrients for varying intervals of time.

400. NORMAN, A. G. 633.524 : 581.192
The composition of some vegetable fibres with particular reference to jute.
Biochem. J., 1937, 30 : 831-8, bibl. 5.

The author analysed by named methods 21 samples of jute, 6 samples of coir, 4 samples of hemp and one or more samples of flax, *Calatropis gigantea*, ramie, pita grass, manilla hemp, *Phormium tenax*, and sisal for their cellulose, lignin, furfuraldehyde yield and uronic anhydride content. Results are discussed. He concludes that vegetable fibres of many types fall into 2 well defined groups according as the cellulose of the fibre is low or high in xylan. The low xylan group includes such high grade fibres as flax, ramie and Italian hemp, while the high xylan group consists of fibres of the coarser type such as jute, manilla hemp and sisal, all of which contain also appreciable amounts of lignin and encrusting hemicelluloses.

401. MANDELSON, L. F. 633.71
The tobacco-growing industry in the United States of America.
Qd agric. J., 1936, 45 : 461-83, 541-74 and 1936, 46 : 4-25, 143-69.

This paper is a general report on observations made by the author during a tour of the principal tobacco-growing areas of the U.S.A. in 1935. Particular attention is paid to the flue-cured tobacco industry, other tobaccos, such as fire-cured, air-cured and cigar tobaccos, being only briefly discussed. The report covers statistics, soils, rotations, seed beds, varieties, cultural practices, fertilizers, curing, storage and manufacture, and diseases and pests.

402. MALCOLM, D. H. 633.71 : 631.531 : 631.588.1
Electrically-heated seed beds.
Tasm. J. Agric., 1936, 7 : 101-7.

Experiments were made in 1935 to test the relative merits of tobacco seed beds heated by means of electric cables and by flue pipes. A description is given of the soil-heating cable apparatus, which can be installed in a bed 45 ft. by 7 ft. for a cost of £9 10s., excluding the cost of labour and of the construction of the beds. The electrically- and flue-heated beds were constructed side by side, kept at the same temperature, and treated in the same manner and both were

in use from 9 August to 16 November. Estimated costs for this period, including interest and depreciation (the same in both cases), wages and power or fuel were, for the electrically heated beds, £6 0s. 9d. [rate $\frac{1}{4}$ d. per K.W.H.] and for the flue-heated beds, £9 8s. 10d. per 6,000 plants. The plants from the electrically-heated beds produced a more even stand in the field and also maintained more vigorous growth up to topping time. The author summarizes the advantages of electrically-heated beds, as found under local conditions, as follows:—(1) Slightly lower constructional costs, (2) halving of labour costs, (3) halving of fuel costs, (4) more even stand of plants, and (5) positive control of heat during the “hardening off” period.

403. MALCOLM, D. H. 633.71-1.8
Tobacco manurial trial, season 1934-5.
Tasm. J. Agric., 1936, 7: 64-7.

A trial was started during the 1934-5 seasons to determine the effect on yield and quality of tobacco of dressings of superphosphate ranging from 360 to 900 lb. per acre, and applied with or without small quantities of nitrogen and potash. The percentages of N were 0 and 3, of P_2O_5 8, 10, 15, and 20, and of K_2O 0 and 4. A latin square lay-out was used, there being 4 replications of each treatment. The soil was an alluvial reddish-brown loam. Tentative conclusions drawn from the first year's results are as follows:—The light dressing of N has increased yields, but produced a leaf harsh in texture and inclined to be heavy, although quality as indicated by grading has not been adversely affected. K_2O , though supplied in very small quantity, has had a marked beneficial effect on both yield and quality. The heavier dressings of P_2O_5 have proved profitable, but it is thought that there may have been some slight deterioration in quality with applications of over 6 cwt. per acre.

404. SPENCER, E. L. 633.71-2.19
Frenching of tobacco and thallium toxicity.
Amer. J. Bot., 1937, 24: 16-24, bibl. 9.

In an attempt to discover whether frenching of tobacco is a toxicity disease 33 elements were tested on young seedlings of Turkish tobacco, *N. Tabacum*, growing in sand cultures and in a sandy loam soil in which frenching does not naturally occur. Of the 33 elements only 7 were toxic in concentrations as low as 5 p.p.m. At this concentration mercury and selenium induced severe stunting but no other apparent symptoms of toxicity, iodine caused small necrotic spots on the lower leaves, while cadmium, cobalt and nickel produced severe chlorosis in the tip leaves but did not cause these leaves to become strap-shaped. Thallium was the only element which, at concentrations of 5 p.p.m. or less, produced chlorosis, strap-shaped leaves and other symptoms peculiar to frenching. The lowest concentrations of thallium which produced chlorosis were 0.067 p.p.m. in nutrient water cultures, 0.10 p.p.m. in sand, 0.25 p.p.m. in a heavy clay loam soil which causes severe frenching, and 0.38 p.p.m. in a light sandy, non-toxic soil. Equivalent amounts of thallium proved more toxic to seedlings growing in sand when added with a water extract of the heavy soil than when added with an extract of the non-toxic soil or with water alone. The water extract of the heavy soil was not by itself toxic but became so when a non-toxic concentration of thallium was added to it. The relative susceptibility of several other species of *Nicotiana* and of tomatoes to frenching and thallium toxicity was found to be similar. Complete control of both frenching and thallium-induced chlorosis was obtained by adding nitrogen salts, a dilute solution (200 p.p.m.) of aluminium sulphate, and by the addition of potassium iodide (60 p.p.m.). Steam sterilization exerted partial control, while zinc sulphate and iron sulphate were ineffective in both cases. The author concludes that the evidence reported in this paper indicates a striking similarity between natural frenching and thallium toxicity, not only with respect to the symptoms they produce on Turkish tobacco, but also with regard to the methods by which they are controlled. It remains, however, to demonstrate the presence of toxic concentrations of thallium in soils which produce frenching, and it is doubted whether present chemical methods are sufficiently sensitive to detect such small traces of thallium.

FLOWER GROWING

405. WITHROW, R. B. AND BIEBEL, J. P. 612.014.44
Photoperiodic response of certain long and short day plants to filtered radiation applied as a supplement to daylight.

Plant Physiol., 1936, 11: 807-19, bibl. 5.

An investigation is reported on the effects of 3 bands of radiation, viz. the red from 650-1,400 μ , the green from 455-550 μ and the blue from 380-510 μ , used to prolong normal winter days [in Indiana, U.S.] to 18 hours, on the photoperiodic responses of 3 long day plants, *Callistephus chinensis* (China aster), *Helianthus cucumerifolius* (sunflower), *Scabiosa atropurpurea* (scabious), and of 3 short day plants, *Salvia splendens*, *Cosmos tripinnatus* and *Tithonia speciosa*. Detailed results are given and the general conclusion is drawn that under the conditions of the experiment red radiation is the most effective in producing the photoperiodic response both in long and short day plants; that some especially sensitive plants, e.g. aster, respond to the blue radiation; and that green radiation has little effect when used in this way.

406. LAWRENCE, W. J. C. 631.85: 635.9
Superphosphate and seedling growth.

Gärners' Chron., 1936, 99: 249-50, bibl. 1.

Phosphates added both to sterilized and unsterilized composts consisting of loam, sand, and moss-peat or leaf-mould have had a remarkable effect upon the germination and early growth of seedlings of many plants grown at the John Innes Horticultural Institute. Species showing particularly marked response include *Cineraria*, *Clarkia*, *Petunia*, *Tagetes*, *Verbena* and some *Primula* spp. Superphosphate thoroughly mixed with the seed compost at a rate of 1½ oz. per bushel has, especially when a little lime is present, given better results than bone-meal or bone-flour.

407. STORCK, A. 635.939.183
 Untersuchungen zur Züchtung einer giftfreien Primel vom "Obconica"
 Typus. II.* (Attempts to raise a non-poisonous primula of the "obconica"
 type.)

Gartenbauwiss., 1937, 11: 151-8.

The primin content of the leaves of 17 cultivated varieties of *Primula obconica* grown under identical conditions was determined gravimetrically. The primin content varied very greatly from 0.0025% of fresh weight in *P. grandiflora oculata* to 0.0148% in a deep dark red, *P. gigantea*. In general the *grandiflora* varieties are low and the *gigantea* high in primin. A comparison of results from the gravimetric method with those obtained by Nestler's primin-sulphuric acid-micro method shows agreement in most cases, but it is considered that the latter method needs certain modification to eliminate possibilities of error.

408. SNYDER, W. C. AND THOMAS, H. R. 635.937.36: 632.8
Spotted wilt of the sweet pea.

Hilgardia, 1936, 10: 257-62, bibl. 7.

The symptoms of a streak disease of sweet peas in California are described. The cause of the disease has been found by inoculation experiments to be a virus identical with that causing spotted wilt disease of tomatoes and infecting a number of other solanaceous plants and also lettuce and garden peas. In addition to mechanical transmissions the virus has been transmitted from lettuce to sweet peas by the agency of *Thrips tabaci* Lind. The authors consider that control of streak would appear to lie in the isolation of sweet pea plants from crops susceptible to spotted wilt and from infested districts, or in the protection of the plants from migrations of infective thrips.

* I appeared *Ibidem*, 1935, 10: 1-50. *H.A.*, 1936, 6: 535.

409. ANON.

635.939.98 : 632.771

The chrysanthemum midge (*Diarthronomyia* sp.).*J. Minist. Agric., Lond., 1937, 43 : 1,158-61.*

This American insect may become a troublesome pest of greenhouse chrysanthemums if not controlled. There have already been two outbreaks in England in recent years. Symptoms of attack are conspicuous cone-shaped galls, occurring usually on the upper surfaces of the leaves, but in severe attacks on buds and stems and resulting in distorted flowers. Control consists of spraying with 95-98% nicotine at a strength of 1-800 water (i.e. 2 oz. per 10 gall.) with the addition of soft soap or other spreader applied fortnightly in spring and autumn. The pest has been included in the Ministry's Destructive Insects and Pests Order of 1933.

410. BOULENGER, G. A.

635.937.34

Revision des roses d'asie. (A revised classification of asiatic roses.)*Bull. Jard. bot. Brux., 1933, 9 : 203-79, 1935, 13 : 165-266, and 1936,**14 : 115-221, bibl. in text.*

The revised nomenclature and descriptions of asiatic roses presented in these three papers are the outcome of an exhaustive study of the literature and of collections in the principal herbaria in Europe. The author divides asiatic types of the genus *Rosa* into 6 sections comprising 94 species, each of which is fully described. His first paper deals with species belonging to the section *Synstylae*, his second with species assigned to the groups *Pimpinelli-Suavifoliae*, *Orientalis* and *Alpinæ-Vestitæ* of section *Eglanteriæ*, and his third with species belonging to the groups *Cinnamomeæ-Caninæ*, *Gallicanæ*, *Elymaiticæ* and *Gymnocarpæ* of section *Eglanteriæ*, and with species belonging to sections *Chinenses*, *Banksianæ*, *Bracteatae* and *Microphyllæ*. Attention may also here be drawn to the comprehensive systematic study of European roses made by the same author on the collection assembled in the herbarium of François Crépin, the results of which appeared under the title: "Les roses d'Europe de l'Herbier Crépin", *Ibidem*, 1924, 10 : 1-192, 1925, 10 : 193-417, 1931, 12 : 1-192 and 1932, 12 : 193-542.

411. DUVERNAY, J. M.

631.542 : 635.9

La taille des arbustes à fleurs. (The pruning of flowering shrubs.)*Bull. Soc. nat. Hort. Fr., 1936, 3 : 154-7.*

The principles underlying the correct pruning of flowering shrubs are outlined. The object of such pruning should be first to shape the bush in the desired form and then to maintain it in as healthy and floriferous a state as possible. The time to prune and the form of pruning will depend upon the growth and mode of producing flowers of each species. In general, however, two groups of plants may be recognized and the principles of pruning them may be summarized thus:—(1) Species which flower during the summer or autumn while making vigorous vegetative growth should be pruned during the dormant period, the newly formed branches being cut back or thinned out. (2) Species which flower in the spring before starting vegetative growth should be summer-pruned as soon as flowering has ceased. In this case the branches pruned are those formed the preceding year or earlier. A number of shrubs belonging to both classes are listed. General principles applicable to both groups are the thinning of excessively numerous branches, the removal of old and sterile stems, dead wood, and inflorescences which have faded, and the cleaning of bark covered with moss.

412. ROSE, F. T.

635.939.124 : 631.541.41

Root-grafting rhododendrons.*Gdnrs' Chron., 1936, 99 : 71.*

Root-grafting has proved a successful method of propagating various rhododendron species and hybrids on *R. ponticum* at Southampton. The roots were trimmed back to about 4 in. below the point of grafting, in some cases almost all the fibrous roots being removed. The method of grafting was of the "saddle" type, and after grafting the plants were plunged in granulated peat moss in a propagating frame. Union was completed in 6-10 weeks, according to variety, about 95% of the grafts "taking", and the plants were then potted and placed in

frames to harden off prior to planting out. January or, early February proved the best time for the operation. Advantages claimed for the method include the prevention of suckering, economy of space, and the saving of time in grafting.

413. KEMP, E. E. 631.535 : 581.144.2 : 635.938.23
Some effects of callus-paring upon root production in cuttings. With special reference to *Camellia Sasanqua*, Thunberg.
Gdnrs' Chron., 1936, 99 : 168-9, bibl. 6.

In June 1934, 25 nodal cuttings of the current year's wood of *Camellia Sasanqua* were inserted in moist coconut fibre in a propagating frame with a bottom temperature of 80° F. and a relative humidity of 96-98%. In August the considerable amount of callus formed was pared and the cuttings reinserted. By January, 1936, only 4 cuttings remained healthy and none had produced roots. In June 1935, a second series of cuttings was taken and these were treated under similar conditions to the first series, but the callus was left unpared. By October of the same year every cutting had rooted. It was observed that prior to rooting the callus became lobulated and the roots arose from these lobes. In the pared series the first callus produced was also lobulated, but, after paring, the surfaces of callus formed subsequently were entire. The anatomy of callus formation was also studied and it was found that the vascular cambium alone is responsible for its formation. The results are held to indicate that generalizations on the anatomy and formation of callus in different species are futile, and that in the case of *Camellia Sasanqua* paring the callus removes the potentiality of root-production. It remains to be proved, however, whether callus-paring is conducive to root-formation in species in which the callus arises from different tissues and is of different structure.

414. BARROWS, FLORENCE L. 635.939.124 : 631.52/53
Propagation of *Epigaea repens* L. I. Cuttings and seeds.
Contr. Boyce Thompson Inst., 1936, 8 : 81-97, bibl. 36.

No particular difficulty was experienced in obtaining plants of *E. repens*, either from cuttings or from seed, though it is noted that the presence of a mycorrhizal fungus in the soil is probably essential. Cuttings and seedlings grew well in soil mixtures of pH 4.65. The methods adopted for successful propagation both by seed and cuttings and the considerable bibliography should prove useful.

415. PURVIS, O. N. 635.944
Recent Dutch research on the growth and flowering of bulbs. I. The temperature requirements of hyacinths.
Sci. Hort., 1937, 5 : 127-40, bibl. 16.

An account is given of some of the results so far achieved at the research stations at Wageningen and Lisse on the growth and flowering of bulbs. The bulb structure and development of hyacinths is described and illustrated. The effects of different storage temperatures on root production, flower-bud formation and flowering as determined by experiment are discussed. As a result of this work a storage treatment to produce early flowering in forced hyacinths is suggested. After lifting the bulbs are stored for a few days at 34° C. resulting at growing time in a more rapid extension, though at the time of application it inhibits the internal development which is in progress within the bulb during its so called "rest" period. The major part of the storage time is subsequently passed at 25.5° C. which favours a rapid development of the inflorescence within the bulb. This treatment must end for a majority of the bulbs just when the initials of the outer petals have formed, i.e. about 12 August in a normal season, 27 August-1 September in a very late season. During the final 3 weeks or so of storage a temperature of 17° C. should be applied. Lower temperatures than this assist early flowering but may induce slightly damaged top flowers while a higher temperature helps to complete flower formation but hinders growth during the forcing period. After storage the bulbs are planted and kept in the dark at 13° C. until the majority of the bulbs have produced shoots 1½ in. above the soil surface and at that precise point they are brought into a temperature of 25° C.,

rapid growth resulting. A transfer to room temperature is made when the flower cluster emerges from the leaves. A different sequence in storage of forcing hyacinths is preferred by the workers at Lisse. They consider a lower first temperature, 20°-23° C., is necessary for optimum results, size of inflorescence and number of flowers. In experiments that have given the best results in producing flat stemmed (fasciated) flower trusses and the largest number of flowers per truss 10 days at 20° C. on lifting followed by 10 days at 25·5° C., one week at 30° C. and then 25·5° C. was the sequence followed. In conclusion the need for similar research under British conditions, in view of the increasing importance of the bulb producing industry in this country, is emphasized. The value of the preliminary work in progress at Kirton Agricultural Institute is acknowledged.

416. VAN SLOGTEREN, E. 635.944
The influence of different temperatures on development, growth and flowering of hyacinths, tulips and daffodils.
Gartenbauwiss., 1937, 11 : 17-34, bibl. 6.

In this paper the author gives a general account with particular examples of the difficulties which face those who attempt to induce early flower production in bulbs. Dames, the Dutch bulb grower, originated the idea some 30 years ago, when by lifting hyacinth bulbs 4 to 5 weeks earlier than usual and storing in a bulb house at a temperature of about 85° F. for some weeks he induced them to bloom some 3 weeks earlier in the following year. Since then with appropriate modifications different bulb storage treatments have also been applied to tulips and daffodils. Among the difficulties encountered are the following:—Low temperature storage capable of inducing early flowering may so upset the carbohydrate metabolism of tulips that the flowers tend to fall over or show some other important blemish. Again high temperatures in the initial stage of storage just after lifting, which may be necessary for controlling a disease or appropriate for inducing early flowering, considerably reduce the number of flowers in the cluster in hyacinths. A certain degree of attainable precocity must, therefore, be sacrificed to quality of flower. Low temperature storage has also been successful in advancing the blooming period of a number of daffodil varieties. Low storage treatment of daffodil bulbs and initial submission of tulip bulbs to high temperature, although eventually inducing early flowering, does not bring about an immediate growth of the flower bud, but actually retards it. A final danger to these "early" bulbs is presented by hot weather during transit, which may seriously damage or even destroy the flower buds.

417. TRIBE, M. H. 635.944 : 632.651.3
Layout for a modern bulb bath.
J. Minist. Agric. Lond., 1937, 43 : 1,139-44.

Accurate determinations of temperatures both of the water and of the interior of bulbs under treatment in a number of commercially used bulb baths revealed the fact that, whereas the temperature recorded by the ordinary bath thermometer was steady at 110° F., that of the bulbs in some parts of the bath did not exceed 108° F., a temperature which takes 4 times as long to kill eelworm. This might well explain instances of otherwise unaccountable reinfestation. The author here describes with diagrams a new bulb bath set up at the Buckland Flower Farm which is said to be highly efficient. Its essential features are:—An ordinary vertical cross-tube boiler. Steam at about 20 lb. pressure passes thence through a Royle reducing valve, being thereby reduced to about 5 lb., to a coil at the bottom of a large cylindrical tank, 6 ft. deep and 6½ ft. in diameter. The tank lies on 3 brick piers and is raised so that, while most of it is on the ground floor of the bulb store, the top projects 2 ft. through the floor above, into the sterilizing room, the floor fitting tightly round the tank to prevent the entry of dust. There is also a pipe for injecting live steam into the tank for rapid heating up, the outlet being fitted tangentially in the bottom of the tank to help circulation by imparting a rotary motion to the water. One way traffic is contrived to prevent reinfestation and details are given of the loading and unloading of the bulbs. Nearly a ton of bulbs can be dealt with at a time in 32 crates of about 65 lb. each. The water is initially brought up to 113° F. by the injection of live steam.

The high efficiency is attributed to the following factors :—The use of (1) crates in place of the bags, which restrict the circulation of the water, (2) a cylindrical not a rectangular tank, (3) ample lagging of the tank and protection from draughts, (4) a large amount of water in proportion to the weight of bulbs, i.e. 1,000 gallons to a ton. It is stated that no difficulty is experienced in keeping the temperature within half a degree of 110° F. It is noted that formaldehyde is used to control fungus attacks and to reduce the time necessary to kill eelworm "wool" at 110° F. Costs are not discussed.

418. BARTON, L. V. 635.935.722 : 631.531
Germination and seedling production in *Lilium* sp.
Contr. Boyce Thompson Inst., 1936, 8 : 297-309, bibl. 21.

Seeds of some lily species germinate without difficulty, while those of certain other species do not develop into plants above ground until the second season. The investigation described here was concerned primarily with the factors associated with delayed germination of seeds belonging to the second group. It was found that seeds of *L. auratum*, *L. canadense*, *L. japonicum*, *L. rubellum*, *L. superbum*, and *L. Szovitsianum* required 3 to 6 months at a high temperature (about 20° C.) for the initiation and growth of the root—which is not dormant—and, after root growth had started, a further period of 6 weeks to 3 months at low temperature (1° to 10° C.) to initiate growth of the first dormant leaves. When this method was put into operation as soon as the seeds were harvested, lily seedlings were obtained above ground in less than one year. As this procedure requires special facilities, however, the practical solution is to sow the seed out-of-doors in spring or summer. Experiments have shown that seeds of *L. auratum* may be successfully sown in the open at any time of the year with the possible exception of the period, August to October, but it is recommended that winter planting should also be avoided as having no advantages, since the seeds will remain dormant until the advent of warm weather in the spring. Tests on seeds of *L. concolor* showed that this species belongs to the group in which both root and cotyledon grow promptly when the seed is sown.

419. PFEIFFER, N. E. 635.935.722 : 581.162.3
Longevity of pollen of *Lilium* and hybrid *Amaryllis*.
Contr. Boyce Thompson Inst., 1936, 8 : 141-50, bibl. 18.

Methods of storing pollen were studied in 4 species of *Lilium* and in a hybrid *Amaryllis*, *Hippeastrum vittatum* Herb. As a result two methods are recommended for conserving the viability of the pollen from these species : (1) Stored at 10° C. *Amaryllis* retained viability for more than 5 months and *Lilium* for more than 7 months. The species varied as to the most favourable relative humidity, 35% being best for *L. auratum*, 50% for *L. speciosum* and the *Amaryllis*, and 65% for *L. longiflorum*. (2) *Lilium* pollen stored at -5° C. and *Amaryllis* pollen stored at -11° C. in gelatin capsules with no humidity control also retained viability satisfactorily, but for fewer months than the pollen stored by the first method. *Lilium* pollen stored under reduced pressure at -5° C. produced almost equally favourable results, but the procedure necessary was more laborious. Methods which gave less satisfactory results are also listed.

420. EVERETT, T. H. 635.935.722 : 631.532
The vegetative propagation of amaryllids.
Gärners' Chron., 1936, 99 : 235.

A note on the method of Heaton, Esson and others, which is a modification of that proposed by Miss Ida Luyton, and has given excellent results with hippeastrums, crinums, haemanthus, narcissi and other bulbous amaryllids in the U.S.A. Under the system no scooping is done, but the bulb is sectioned vertically into 8 or 16 parts, each part being subsequently divided vertically. Each fraction is planted in flats containing peat moss under ordinary greenhouse conditions, and in due course one or more bulbs develop between the scales. In some cases final fractions representing one sixty-fourth or even less of the original bulb have proved successful, but in other cases it has been found wiser not to proceed so far with the division.

421. HAGEMANN, P. 577.15.04 : 635.944

Ueber durch β -Indolylessigsäure ausgelöste Parthenokarpie der Gladiöle.
(The production of parthenocarp in gladiolus by indoleacetic acid.)

Gartenbauwiss., 1937, 11 : 144-50, bibl. 27.

By the use of β -indoleacetic acid as a sodium salt in the form of paste on the ovary the author managed to induce parthenocarp in gladiolus. He also tried phenylacetic acid but without result.

422. DENNY, F. E. 635.944

Storage temperatures for shortening the rest period of gladiolus corms.

Contr. Boyce Thompson Inst., 1936, 8 : 137-40, bibl. 6.

When corms of 8 different gladiolus varieties were subjected to a storage period of 6 weeks at 3° and 10° C. starting 10 days after harvest, all the corms germinated much earlier than did a similar series stored at 30° and 35° C. Three weeks' storage at the low temperatures also hastened germination in all varieties except Mrs. F. C. Peters and Mrs. Frank Pendleton. When the beginning of the storage period was delayed until 52 days after harvest the temperature effect varied with the variety tested; low temperature storage produced earlier germination in Halley, Mrs. F. C. Peters, Mrs. Frank Pendleton, and Dr. F. E. Bennett; high temperature storage produced earlier germination in Alice Tiplady and Souvenir; while with the varieties Mr. W. H. Phipps and Giant Nymph there was no difference in the speed of germination between corms stored for 6 weeks at 3° or 35° C.

423. DARNELL, A. W. 635.944 : 635.936.751

The genus *Anemone*.

Gdnrs' Chron., 1935, 98 : 386-8, 408-10, 444, 1936, 99 : 10-1, 28, 89-90, 251, 283-4, 314, 353, 374, 405-6 and 1936, 100 : 12-3, 28-9 and 47-8.

Descriptions are given of 106 species of *Anemone*. These include only the true anemones, and the genera *Pulsatilla* and *Hepatica* are omitted. The definitions as to species and sections given by Ulbrich in *Engler's Botanische Jahrbücher* for 1905 have been adopted, so far as he goes, and references are also given to other papers in which certain of the species have been illustrated.

424. WEIGEL, C. A. AND NELSON, R. H. 635.944 : 632.654.2

Heat treatments for control of bulb mite on tuberose.

J. econ. Ent., 1936, 29 : 744-9, bibl. 1 in text.

The bulb mite, *Rhizoglyphus hyacinthi*, commonly attacks the dormant bulbs of tuberose, *Polianthes tuberosa*, especially when they are incompletely cured or dried. As in the case of attacks by the root-knot nematode, *Heterodera marioni*, infested stocks of bulbs become completely destroyed unless control measures are undertaken. The tests described here have shown that treating the bulbs in hot water at 110° F. for 1 hour, or with vapour heat at 114° F. for the same period, is completely effective against the mite. Thus the treatments previously found to be effective against the nematode, namely hot water at 116° F. for 1 hour, at 118° F. for half an hour and vapour heat at 122° F. for half an hour, will also control the bulb mite. Tolerance tests at these temperatures and durations have shown that neither bulbs of flowering size nor bulbs of planting stock size are adversely affected, and that the application of the treatments is practicable on a commercial scale.

425. BUDDIN, W. 635.944 : 632.48

The grey bulb rot of tulips and its control.

J. Minist. Agric., Lond., 1937, 44 : 54-9.

The disease is caused by the fungus *Sclerotium Tuliparum* Klebahn. The disease usually attacks the young shoots of forced or outdoor tulips and other bulbous plants, causing abortion

of the flower and rotting of the greater part of the bulb. It usually occurs in contaminated soil and is not transported with the bulb. Infested soil should be steam sterilized or replaced, but, if this is impossible, planting the tulips in such a way that half or two-thirds of the bulb projects above soil level and covering them during preliminary rooting with good long straw, will result in a fair crop even in contaminated soil. Soil treatment with formalin, effective against shanking (*Phytophthora* spp.), is useless against grey rot.

CITRUS AND SUB-TROPICALS.*

426. PREST, R. L. 634.3

Citrus culture in Queensland.

Qd agric. J., 1936, 46: 790-812 and, 1937, 47: 75-92, 210-8, bibl. 6.

This is a very complete account of the methods of citrus cultivation suitable for Queensland. They vary, however, but little from the methods employed in up-to-date citrus countries so that the value of the information supplied is more than local. The principal stocks used are seedling sweet orange or rough lemon. Sour orange is less common, possibly because of its slower growth. The section on pruning is worth attention. The author does not believe in allowing the trees to take care of themselves after the initial frame work has been built up. Sweet orange, mandarin and lemon have each to be given a different treatment and these are described. Instructions are also given for profitably renovating old and decadent trees.

427. METTERS, F. H. 634.3

The citrus industry of America.

J. Dep. Agric. S. Aust., 1936, 40: 222-36.

The author paid a visit to the U.S.A. in 1935-6, and in this paper he reports his impressions of methods of growing, harvesting, packing and marketing oranges practised in southern California. In concluding, he lists a number of factors which have contributed to the success of the industry in that country, and, based on these, suggests that the following practices be adopted in Australia. (1) In choosing nursery trees purchase only those which have been budded from selected trees on to sweet or sour orange stocks. It may be noted here that in California the present tendency is towards the supercession of the sour by the sweet orange as the principal stock. Recent plantings comprise about equal numbers of trees on the two stocks, while the rough lemon is never used. (2) Eliminate all off-type and unprofitable varieties. (3) Plant efficient windbreaks. (4) Apply heavy annual dressings of animal manures and nitrogen, and grow cover crops. (5) Apply lighter and more frequent irrigations, even if the additional cost has to be met by reduced cultivation or other means. (6) Take drastic steps to eradicate all pests, particularly red scale. (7) Prune the trees only lightly, but remove all dead wood and all growths near the ground. (8) Use clippers, picking bags and gloves in harvesting. (9) Employ, where practicable, selected men under expert supervision for harvesting. (10) Use gloves for all hand operations in packing houses. (11) Make every effort to obtain a rapid service of refrigerated rail vans for export fruit, especially during spring and summer months.

428. BENEMERITO, A. N. 634.31

The occurrence of navel oranges in Kwangtung Province.

Lingnan Sci. J., 1936, 15: 471-6, bibl. 17.

After giving a brief history of the Washington Navel orange the author describes three strains of Navel oranges which are to be found in the province of Kwangtung, namely the Chi Chang or Luntau Navel, the Hushuae and the Hoichow Navel. Budwood has been taken and used for propagating and the resulting trees will be used for further study.

* See also 318.

429. ALEXEYEV, V. P. 634.3-1.523
The methods of I. V. Mitchurin and T. D. Lysenko and the prospects of breeding citrus in the arid sub-tropics. [Russian, English summary.]*
Soviet Subtropics, No. 1 of 1937 (29), pp. 35-46.

The possibility is discussed of producing hybrid citrus varieties that will stand the severe climatic conditions (drought, heat, cold) of the arid sub-tropics of U.S.S.R. [The Institute for Scientific Research in the Arid Sub-tropics has recently been formed in Russia.—ED.] It is proposed that the methods of Mitchurin should be followed. Part of the teaching of Mitchurin is that it is not ready made characters which are transmitted by inheritance and will function under any conditions but only the potential possibilities of their development and that the development takes place according to the environment in which the hybrid is brought up. Thus, to obtain the widest range of possibilities, it is necessary that the two parents should come from widely different localities or have widely different characters. The offspring of parents resembling each other or from similar localities are less adaptable, and the directions in which they can be developed by environment are correspondingly fewer. The paper goes on to show how these methods may be applied to citrus, a group particularly favourable for experiment since it contains species hydrophytic and xerophytic, deciduous and evergreen, frost resisting and tender and a host of intermediate forms in each class. As an example of how the method would work the author outlines a scheme of hybridization for the production of a frost resistant, salt-resistant rootstock suitable for arid conditions and shows how the hybrids would be treated environmentally so as to develop the necessary characteristics.

430. MOORE, J. A. 587.519 : 581.47
Floral anatomy and phylogeny in the *Rutaceae*.
New Phytol., 1936, 35 : 318-22, bibl. 5.

The author criticizes the present classification of the *Rutaceae*, pointing out some of the existing anomalies.

431. CARYL, R. E. 634.31 : 575.252
The future of bud selections.
Calif. Citrogr., 1937, 22 : 289, 328-30.

The principles of bud selection in regard to citrus are discussed. By its means thorns have been eliminated, late and early types found, minor variations removed and quality improved. Concrete instances are given of these results.

432. MENDEL, K. 634.3-1.541.5
Some considerations on the anatomy and physiology of citrus budding.
Hadar, 1937, 10 : 60-4, bibl. 4.

The processes of healing of wounds made by budding are examined in the case of sour orange and sweet lime. The anatomical progress of the bud union is the same in both. Correctly performed budding, using either the upright or inverted T, causes no permanent injury to the rootstock. The small pad at the lower end of the shield in an inverted T cut is caused by exuberant growth and not by an accumulation of photosynthetic products. In oranges no border line between scion and rootstock can be determined anatomically after successful budding. During the first few months all parts of the rootstock are better supplied with photosynthetic products than the bud. The adjustment of the bend in the stem after removing the stub is achieved by uneven growth of the wood at opposite sides of the rootstock and scion.

* Translation available.—ED.

433. HARVEY, E. M. AND RYGG, G. L. 634.3 : 664.85.3
Behavior of citrus fruit under special respiratory conditions as an expedient index of vitality.
Plant Physiol., 1936, 11 : 647-51.

This is a preliminary report of work, the final aim of which is to produce some simple indicator of the vitality of any given citrus fruit with regard to its keeping quality in store and transport. The general method adopted was to fill a container, capable of being made quite air tight, with fruit and then record the pressure changes as respiration of the fruit altered. The technique and preliminary observations are recorded.

434. FELLERS, C. R. AND SMITH, E. G. 634.331 : 581.192
Chemical composition and fermentation studies of citron.
J. agric. Res., 1936, 53 : 859-67, bibl. 19.

Chemical analyses and vitamin A and C determinations were made on citrons, obtained from Puerto Rico, both before and after preserving. In the case of the fresh fruit the pulpy portion including the seeds was discarded prior to analysis. The results of the chemical analyses are tabulated together with those of several partial analyses found in the literature on the subject. They indicate that the citron is characterized by high moisture, medium sugar, ash and fat, and low crude fibre contents. Moderate amounts of calcium, potassium, phosphorus and copper were present in the ash. The iodine content was low. The vitamin C content of fresh, unripe citron was found to be very high, corresponding to 6 international units per gram, but very little of this was retained after fermentation in brine, and it is concluded that the preserved or candied citron which is made from the desalted, brined fruit contains little or no vitamin C. The vitamin A content of green, fresh citron was estimated at 0.8 to 1 international unit and that of the candied peel at slightly less. In fermentation studies the findings of Hollande and Chadeaux* with regard to the micro-organisms responsible for the characteristic brine-fermentation of Corsican citrons were corroborated for Puerto Rican citrons. A yeast, designated *Saccharomyces Citri medicae*, and *Bacillus Citri medicae* were found in large numbers in the fermenting brined citron. The acidity of the brine increased steadily from 0 at the beginning of fermentation to 6 to 7 g. of acid (calculated as acetic per litre) in 14 days, after which it remained nearly constant. In experiments on the preserving of citron following desalting the use of 35% of glucose with the sucrose yielded a peel of excellent flavour, texture and colour, whereas pure sucrose gave a peel that was too firm in texture and of poor keeping quality owing to sugar crystallization. A moisture content of preserved (candied) citron peel of 17 to 19% proved sufficiently low to prevent yeast fermentation or mould growths even after long storage.

435. PUTTERILL, V. A. 634.3-1.547.6
The maturity test for citrus fruits.
Fmg S. Afr., 1937, 12 : 209-11, 215.

The equipment required for juice and maturity tests of citrus, the method of conducting the test and of calculating the results are described and explained very fully.

436. ALLWRIGHT, W. J. 634.3-1.67
Irrigation practice in citrus orchards.
Citrus Grower, 1936, No. 47, pp. 1-9.

The author records a number of questions asked by, and replies given to, growers with special reference to the basin system of irrigation during a recent tour of Rustenburg district, Transvaal. The questions asked concerned (1) the method of irrigation to adopt, (2) making irrigation basins, (3) the maintenance of the humus content of the soil without cover crops, (4) cultivation in Rustenburg orchards, (5) intervals between irrigation, (6) the aeration of the soil without

* Étude bactériologique de la fermentation en eau de mer des cédrats de Corse, destinés à la confiserie.
Bull. Sci. pharm., 1924, 31 : 458-71, 527-39.

cultivation after each irrigation and the effect of cultivation on the conservation of moisture, (7) thrips control and the carting of fruit from the orchard as affected by the presence of permanent basins, (8) the incidence of collar rot and root rot where the basin irrigation method is used, (9) the danger of over-irrigation with the basin system, and, finally, (10) the practical results that basin irrigation has had in the Rustenburg area. To each of these questions more or less detailed answers are supplied. In reply to the tenth and last query the author notes that in experimental plots the substitution of basin irrigation for the part furrow—part basin system resulted in an increased yield of nearly 1 case of fruit per tree in the first year and of very nearly 3 cases in the second year after changing the system, and, in addition, increased the average juice content of Washington Navel oranges from 44 to 48%. In commercial orchards improvements have been even more striking, the average crop per tree being more than doubled and the juice content being increased from 44 to 49%.

437. ALLWRIGHT, W. J. 634.31-1.8
Progress report on the fertilizer trials at Rustenburg, Western Transvaal.
Citrus Grower, 1936, No. 45, pp. 3-7.

Fertilizer trials were started in 1932 in three orange groves containing Washington Navel, Valencia and seedlings, respectively. [Age not stated, but presumably trees were in full bearing.—Ed.] The soil in all cases was a red sandy loam of great depth. The fertilizer treatments consisted of various combinations of NPK, kraal manure and nil. A randomized block lay-out giving 4 replicates of each treatment was adopted in all three trials. The fertilizers were applied towards the end of July (winter) in each year and the kraal manure was broadcast in February. Irrigation on the basin system followed immediately after each application. Results were treated statistically and are here summarized for the years 1933 to 1935 inclusive. *Effect on yield.* With the Navels only sulphate of ammonia (N), and N + kraal manure increased yields significantly in all three years. In 1935 N + kraal manure produced significantly higher yields than did N alone. With the seedlings and Valencias yields were only affected in one of the years by any of the commercial fertilizers, but kraal manure significantly increased the yields of seedlings in two years and there are indications that it is also increasing the yields of Valencias. *Effect on juice percentage of the fruit.* N decreased the juice percentage by just over 2% in all three varieties in 1934 and 1935, the decrease in 5 cases out of 6 being significant. In 1935 P (superphosphate) increased the juice percentage in all varieties by just over 2%, which was significant in each case. *Effect on acid content of the fruit.* With Navels in 1935 N + kraal manure gave a significantly lower acid content than N alone, while sulphate of potash (K) increased and P decreased the acid content significantly. K and P had a similar effect on Valencias in 1935, and N alone significantly increased the acid content in both 1934 and 1935. No treatment has so far had any significant effect on the acid content of the seedlings. It is recalled that the reduction in acid content following applications of P has been reported previously from South Africa.* *Effect on soluble solids content of the fruit.* None. *Effect on soluble solids: acid ratio of the fruit.* With Navels and Valencias in 1935 P increased and K decreased significantly the soluble solids: acid ratio. With Valencias in 1934 and 1935 N also decreased the ratio significantly. With the seedlings no treatment has so far affected the ratio. *Effect on density and colour of tree foliage.* N + kraal manure has resulted in denser and greener foliage in all three orchards. The absence of kraal manure has led to sparser foliage and some dead wood, while the absence of both kraal manure and N has led to still sparser foliage, yellowish colour and more dead wood. *Effect on size of fruit and texture of its rind.* The general opinion is that N with or without kraal manure has resulted in coarser textured rinds, a fault which becomes more accentuated the longer the fruit remains on the tree after reaching maturity. P has produced smoother and finer textured rinds, and K when used in conjunction with kraal manure and/or N appears to have produced smaller fruit. *Recommendations.* On a basis of these results growers with orchards on similar soils in the Western Transvaal are recommended to apply 150 to 200 lb. well rotted kraal manure

* van der Plank, J. E. and Turner, F. A. S. *Fmg S. Afr.*, 1936, 11: 59-60. *H.A.*, 1936, 6: 542.

in June or July per bearing tree per annum. In addition 5 lb. sulphate of ammonia should be applied to Navels towards the end of July, and 10 lb. superphosphate to large seedlings and somewhat less to full bearing Navel or Valencia trees. It is not suggested that K should be applied in any form.

438. HAAS, A. R. C.

634.3-1.535 : 631.84

Nitrogen fertilization and root aeration.

Calif. Citogr., 1937, 22 : 286, 332, bibl. 3.

The results are reported of preliminary experiments to determine the growth response of tops of citrus cuttings to equal amounts of nitrogen in various forms. They suggest that citrus roots may secure oxygen from nitrates for use in root respiration and may bear on the question of the form of nitrogen best suited for the growth of citrus in soils in which aeration is of importance. Excellent results were obtained in water cultures with nitrate nitrogen (NO_3) combined with a suitable base. In cultures grown in unaerated solutions, either deficient in nitrogen from the start or becoming so during the experiment, the roots became badly affected, gelatinous and with a strong odour of decay. The addition of calcium nitrate solution cleared up the trouble. Similar cultures lacking nitrogen but kept continually aerated showed no root injury, though root growth stopped and leaves showed nitrogen deficiency.

439. ALLWRIGHT, W. J.

634.31-1.541.44

Girdling Washington Navel trees.

Citrus Grower, 1936, No. 46, pp. 7-15, bibl. 4.

The design of the girdling experiments in three Washington Navel orchards in the Rustenburg district, Western Transvaal, and the results obtained in the first two seasons have already been reported. (*Ibidem*, 1935, No. 43, pp. 17-23 ; *H.A.*, 1936, 6 : 138.) Girdling in one orchard was discontinued after the first year's results, in the second orchard after the 1933-4 season, and in the third orchard after the 1935-6 crop. Girdling in one year was found to promote yield increases of 8.1 to 20.4% in the subsequent crop, but girdling in two and three successive seasons produced smaller increases of 0.7 to 7.8% and 2.3 to 3.0%, while girdling in four successive years actually resulted in a decrease of 5.5% in the crop by comparison with ungirdled check trees. Moreover, in trees girdled once and then left ungirdled the second crop was decreased by 0.0 to 13.5% by comparison with control trees. The third crop after girdling in one year again showed a slight decrease, and it was not until the fourth crop that the trees had fully recovered from the effects of one girdling. Girdling was also found to increase the soluble solids in the fruit, but to too small an extent to be of any practical value. When performed continuously for more than 2 years, however, it resulted in a decrease in juice percentage, an increase in acid content and a decrease in the soluble solids : acid ratio, and thus affected quality adversely. None of the treatments had any appreciable effect on the size of the fruit, nor, so far as could be judged from observations, on the colour and density of the foliage or the growth of the trees. On a basis of these results growers are advised not to girdle their citrus trees.

440. SHAMEL, A. D.

634.31-2.111

Frost injury to bearing orange trees.

Calif. Citogr., 1937, 22 : 290-307.

In view of the severe frost of 1937 the author discusses some frost effects noted during the past 25 years. No injurious effects of whitewashing trees have been noticed [but see 442.—ED.] and he considers it to be beneficial in preventing sunburn. There is no doubt that frost-defoliated trees do occasionally suffer severely from sunburn. Foliage damaged trees are helped by nitrogenous fertilizers especially in orchards where nitrogen may be low. The amount applied and the frequency of application depends on previous manurial procedure. When foliage is

much reduced by injury, irrigation should be less frequent. Cases of root rot of damaged trees are traceable to a continuance of normal irrigation. Pruning should be delayed for some months. Binding of split bark was useless unless done immediately. The cutting away of the damaged part of split trunks and treating the wounds with disinfectant, covering subsequently with grafting wax, is possibly of value.

441. **BLANCHARD, V. F.** 634.3-2.111
Rebuilding frost injured citrus trees.
Calif. Citrogr., 1937, 22: 184, 216-8.

In treating frost injured citrus trees the following general rules should be observed:—No pruning the season following a freeze and the next year only a light thinning out where foliage is heavy, and the removal of dead wood; whitewashing as a protection against sunburn, using the formula stone lime 50 lb., water 10 galls., salt 4.5 lb., or hydrated lime 50 lb., water 8 galls., salt 4 lb.; before applying wound-healing paint disinfect with denatured alcohol 1 quart, mercuric cyanide $\frac{1}{4}$ oz., water 3 quarts. It is essential that cracked frozen wood should have time to dry out before sealing or heart rot will occur. Instructions are given for the best way of promoting new growth and rebuilding trees in five different degrees of frost injury, from cases where the injury is confined to the outer shell of foliage down to cases where the whole tree is injured to below the bud union.

442. **WEBBER, H. J.** 634.3-2.111
Is whitewashing to prevent sunburn on frozen citrus trees a safe practice?
Calif. Citrogr., 1937, 22: 185, 214.

The author is inclined to believe that the whitewashing of frozen citrus trees is more harmful than beneficial [but see 440.—ED.]. At the time of freezing the weather is usually cool and will not warm up for 6 weeks or more so that sunburn is improbable in any case, besides which whitewashing has been known to delay growth for as much as three weeks, and in other cases seriously to injure young foliage.

443. **THOMPSON, D. J.** 634.3-2.111
Covina grower uses furnace heat for frost protection.
Calif. Citrogr., 1937, 22: 314, 316.

A system is described of orchard heating by means of hot air from a central furnace carried through pipes laid on the surface of the ground. The system, so far only used by the inventor, is now to be manufactured commercially. Consumption of fuel is said to be extremely low. The upward air movement from the warm pipes is thought to prevent the frost from settling on leaves and fruit, which always remain perfectly dry. In the recent severe frosts in California no fruit or trees were damaged in the orchard using this system.

444. **MATTHEWS, I. AND POWELL, H. C.** 634.3-2.19
Spraying citrus trees with zinc sulphate.
Citrus Grower, 1936, No. 44, pp. 20-1.

Trials with zinc sulphate spray as a corrective for mottle leaf, started in the Sundays River Valley in 1933, have proved so successful that the general use of zinc sulphate in the area is now recommended. The spray mixture of 10 lb. zinc sulphate, 5 lb. hydrated lime, $\frac{1}{4}$ lb. spreader per 100 galls. should be applied at a rate of about 2-3 galls. per 8-year-old tree at a period when the tree is not making active growth, since young foliage and very small fruits are liable to be injured. Mottle leaf usually disappears after 3 to 6 months and the beneficial effects of the treatment last at least 1 year and possibly for longer periods. Even trees not affected by mottle leaf have been shown to benefit from the use of this spray. Preliminary trials with zinc oxide spray as a cheaper substitute for zinc sulphate have also given good results. A detailed report on this work is to be published elsewhere.

445. BARTHOLOMEW, E. T. 634.334-2.19-1.67
Endoxerosis of lemon fruits as affected by the application of different amounts of irrigation water.

Phytopathology, 1936, 26 : 1,149-54, bibl. 9.

The term "endoxerosis" (internal drying) replaces "internal decline" used in earlier publications to denote an internal, non-pathogenic disorder which appears in many lemon fruits as they approach or reach maturity. The experiment described here was made to determine whether or not the disorder might be largely influenced by the excessive withdrawal of water from the fruits by the leaves during periods of high temperature and low relative humidity. 12 Eureka lemon trees budded on sour orange stocks were planted in 1927 in tanks containing soil with a moisture equivalent of 11% and a wilting point of 3.5 to 4.0%. Up to May 1931 all the trees received the same amount of water, but thereafter they were divided into three groups, the first being left unirrigated until the water content of the soil mass had fallen to 6.8%, the second until it had fallen to 5 to 6% and the third until it had fallen to 4 to 5%. The greatest quantity of endoxerotic fruit and the greatest number of fruits that became endoxerotic before reaching maturity were produced by the trees in group 3, which had received the fewest irrigations. The trees in group 2, receiving the medium amount of water, produced the greatest amount of good and the least number of endoxerotic fruits during the period of differential treatment. These results are held to substantiate the evidence from previous experiments that the withdrawal of water from the fruit during periods of excessively high temperatures and low relative humidity is an important factor in the production of endoxerosis.

446. STRICKLAND, A. G. 634.3-2.19
Mottle leaf in citrus.

J. Dep. Agric. S. Aust., 1936, 40 : 45-6.

An investigation in a grove affected by mottle leaf showed the existence of two adverse factors which might possibly be associated with the disorder, namely an excessively high salt content of the soil and irrigation water and the presence of heavy root infestation by the citrus nematode, *Tylenchulus semipenetrans*. Suggested remedial measures include the use of reservoir water, if feasible, and irrigation of a flood or semi-flood type to wash salts out of the surface soil. Trees beyond hope of recovery should be removed, and it is suggested that a trial planting might be made of trees on Seville stock instead of on rough lemon, since possibly the former may be more satisfactory where nematode and soil salinity are factors of importance. No means of eradicating the nematode are known, but it is thought that measures designed to maintain vigorous growth of the trees should prove helpful.

447. SIMMONDS, J. H. 634.3-2.3/4
Citrus diseases.
Qd agric. J., 1937, 47 : 142-53.

The following citrus diseases are described under Queensland conditions and methods of control are suggested: Black spot (*Phoma citricarpa*). This fungus disease is the most common and destructive in Queensland; it is restricted to Australia and some Eastern countries. Melanose (*Phomopsis Citri*).—Scab (*Sporotrichum Citri*).—Emperor mandarin brown spot, a serious but local disease of unknown origin attacking leaves, branches and fruit of this variety.—Blue mould (*Penicillium* spp.).—Brown rot (*Phytophthora citrophthora* and *P. parasitica*) and Stem end rot (*Phomopsis Citri* and *Diplodia natalensis*). These cause loss both in the field and in store.—Cobweb or Pink disease (*Corticium salmonicolor*).—Psorosis.—Exanthema, possibly due to copper deficiency and in Queensland associated with very light sandy soils lacking in humus.—Mottle leaf or Foliocellosis, a physiological disease probably nutritional and prominent here on light sandy soils.—Collar rot or Gummy, particularly on lemon or lemon rootstock.—Armillaria root rot (*Armillaria mellea*).—Sooty mould (*Capnodium* sp.) comparatively harmless.—Smoky blotch (*Leptothyrium* sp.).

448. HECTOR, J. M.

634.3-2.3

The control of citrus gummosis.*Citrus Grower*, 1936, No. 47, pp. 13-4.

Steps which should be taken to prevent infection by *Phytophthora citrophthora* and to control the disease are enumerated concisely. Among control measures the methylene blue treatment which is still in the experimental stage is described in some detail. The solution is made by adding 1.5 g. of refined, or 6 g. of commercial, methylene blue to 1,000 c.c. water. A hole, about $\frac{3}{4}$ in. deep, is drilled with a $\frac{1}{2}$ in. brace into the trunk immediately above each lesion. Into this hole between 100 and 250 c.c. of the solution should be injected by means of a self-contained pressure container [not described.—ED.]. The whole of the liquid will pass into the tree in about an hour, spreading upwards and downwards and to a limited extent laterally. In the case of wide lesions simultaneous injection into 2 holes $\frac{3}{4}$ in. apart is suggested. In cases of severe attack several injections may be necessary.

449. HAINES, G. C.

632.752: 634.3

Control of the citrus mealy bug.*Fmg S. Afr.*, 1937, 12: 207, 215.

Spraying and fumigation have proved unsatisfactory with this pest which has been troublesome in the eastern Cape Province. It is largely distributed by ants and if they can be kept out of the trees the natural enemies, chiefly the ladybird, will probably obtain control. The ants can be dealt with by banding with a sticky material or by baiting. In banding the only access to the tree for the ant must be by the trunk; a branch touching the ground or weeds touching any part of the tree above the band will render such efforts nugatory. Formulae for the sticky material and for two types of bait (Barber and Bishop) are given, and technique is described. Baiting has the advantage over banding that it destroys the ant colonies.

450. HAAS, A. R. C.

634.653-2.19: 581.11/14

Growth and water relations of the avocado fruit.*Plant Physiol.*, 1936, 11: 383-400, bibl. 7.

Heavy loss of thin-skinned avocado fruits is due to end-spots, namely a spoilage which affects mature fruits on the tree. The larger end gradually withers and dies and in some cases the cracking may proceed until the seed is exposed. Since thin-skinned varieties are preferred, the incidence of end-spots is likely to become an increasing problem. In this paper certain phases of the growth and water relations of the fruit are considered. No conclusions are drawn regarding the horticultural application of the results. Growth of fruits governs the distribution of stomata which is in turn related to water loss and aeration. Hence, observations were made on the amount of growth in different portions of the fruits of named varieties. Stomatal distribution and functioning were next examined and water relations were studied by observing the reactions of fruits immersed for varying periods in distilled water, both on the tree and after picking. Results are tabulated and summarized.

451. FRANÇOIS, M. T.

633.85: 581.192

Sur l'analyse des graines de tung (*Aleurites Fordii*) cultivées au Maroc (récolte 1933). (**The analysis of tung-oil seeds harvested in Morocco in 1933.**)

Agron. colon., 1936, 25, No. 225, pp. 89-91.

In samples analysed shortly after they had been harvested the kernel represented 61.6% of the whole seed and contained 55.2% oil compared with 34% in the whole seed. Chemical determinations made on the oil show agreement with specifications established in other countries, but the specific gravity of the oil (0.9445), as found in this and previous samples, was so much higher than the figure at present accepted as to suggest that samples of this type had been adulterated with castor-oil. It is, therefore, recommended that the present specifications for the specific gravity of tung-oil should be revised to include higher densities and thus avoid accusations of adulteration.

TROPICAL CROPS.

452. COPELAND, E. B. AND COLLADO, T. G.

588.5

Crop ferns.*Philipp. J. Agric.*, 1936, 7: 367-77.

The cultivation is described of 2 edible ferns of the Philippines, *Athyrium esculentum* and *Ceratopteris siliquosa*. The edible fronds of these ferns had hitherto always been collected from the wild, and cultivation on a field scale had never before been attempted. It was found that *Ceratopteris*, which requires very wet conditions, e.g. those of a former rice field, could be multiplied very rapidly from buds. Two microlepidoptera, one doing serious damage, were noted and studied, but during the study the whole stock of plants was attacked by a fungus—possibly, as investigation suggests, a *Colletotrichum*—and completely wiped out. As the cultivation of this plant appears to be very profitable, strong endeavour is being made to overcome the trouble. *Athyrium esculentum* (or Paco), which is equally palatable and may even lend itself to canning, multiplies abundantly by underground rhizomes which yield in 6 months and by their numbers keep all weeds in abeyance. Plants should be set 40 cm. apart in a wet soil. They receive no further care. Harvest is continuous and consists of the upper 5-8 cm. of the growing leaf tip, the remainder of the leaf being left on the plant. Moribund fronds must be removed at frequent intervals in order to keep a close stand in good health. Cultivation being in its infancy data are scarce, but in the Philippines, at least, it promises to be highly remunerative if present prices are maintained.

453. WILLIMOTT, S. G.

633.689

A study of *Colocasia*.*Cyprus agric. J.*, 1936, 31: 94-108, bibl. 30.

Colocasia antiquorum Schott, taro, tania or poi, to mention only a few of its many local names, has been cultivated as a food plant in the tropics and subtropics from the earliest times. This paper deals largely and thoroughly with its nutritional value as a staple energy food. Its extreme digestibility when properly cooked is due to the alkaline reactions of its starch (as opposed to the acid reaction of cereal starch). In fact, the author mentions, in the Kanaka language of poi-eating Polynesia there is no word for indigestion.

454. DE PERALTA, F. AND PAGUIRIGAN, D. B.

633.71-1.543.1

The effect of time of shading tobacco upon yield and quality of wrapper-leaf tobacco in the Philippines.*Philipp. J. Agric.*, 1936, 7: 327-51, bibl. 6.

High grade leaf-tobacco wrappers comparable to imported Sumatra wrappers can be profitably produced under abaca-cloth shade in the Philippines. The Simmaba variety gives the most profitable results. The shade should be applied 5 weeks after transplanting when the plants are knee-high; shading applied later than 6 weeks after transplanting is useless. The change in leaf structure under shade from small and thick to broad and thin is dependent on the aggregate effect of the aerial environment under shade being such as to be unfavourable for rapid transpiration, namely reduced sunlight and wind, relatively low soil and air temperatures, high air humidity and low soil moisture evaporation.

455. MAHER, C.

633.73

Arabica* coffee and the plant breeder.E. Afr. agric. J.*, 1937, 2: 298-304.

This article, which is intentionally written in the abstract [author's note.—ED.], deals with the general principles of plant improvement with special reference to *arabica* coffee. Technical details are not discussed.

456. DE LIGT, N. M. 633.73-1.541.11
Coffea arabica als onderstam. (*C. arabica* as a rootstock.)
Bergcultures, 1936, 10 : 154-6.

Robusta scions of an unknown variety grafted on *arabica* seedling rootstocks in Java grew strongly. The bean produced by these grafts had a peculiarly oblong appearance. The taste of the coffee also appeared to be an improvement on that of the coffee from unworked scion parents, but neither of these differences was maintained when the plants were tried elsewhere. A further series of grafts, which have not yet fruited, consisting of *arabica* seedling stocks and *robusta* and *Conuga* scions show an extraordinarily fine development of both root system and scion, when compared with seedling ungrafted *arabica* of the same age and even 6 years older. The application of the scions seems to have transformed the weakly *arabica* stocks and at the same time to have benefited the scions. The possible uses of these combinations, should further tests prove favourable, is discussed.

457. NUTMAN, F. J. 633.73-1.543.1
 Bearing of recent physiological research on the shade problems of *arabica* coffee cultivation.
E. Afr. agric. J., 1937, 2 : 366-70, bibl. 6.

Experiments in the field and laboratory have shown that in coffee, for maximum photosynthesis, the light falling on the leaf should be rather less than one-third of full mid-day sunshine. In leaves in full sunlight photosynthesis ceases at 9 a.m. and does not begin again until 4 p.m. Moderate shade produces normal rates of photosynthesis, and very dense shade, as found in the interior of the coffee bush, results in a low rate but higher than in sunlight. The cessation of photosynthesis in sunlight in coffee is attributed to the great sensitivity of the stomata to light. Shade, therefore, would appear to be beneficial to coffee, but it depends on local conditions whether this is obtained by the natural cloudiness of the district, by shade trees or by so training the tree that it shades itself. In this latter respect the author mentions a tree which on a completely cloudless day had 45% of its leaves shaded all the time, while 67% were exposed to the sun for less than 2 hours. [A scientific paper by the author on this recent work on photosynthesis in coffee has been contributed to *Annals of Botany* and will be abstracted as soon as it appears.—ED.]

458. RISBEC, J. 633.73-2.4/7
 Les parasites du caféier en Nouvelle-Calédonie. (Diseases and pests of coffee in New Caledonia.)
Agron. colon., 1936, 25, No. 226, pp. 105-23.

Notes are supplied on two fungus diseases, *Hemileia vastatrix* and *Stilbum manum*, and on a parasitic plant, *Loranthus* sp., and descriptions, for the most part brief, are given of the following insect pests, the injury they cause and methods of control: *Coffearhynchus neocaledonicus* n.sp., *Enicodes* spp., *Araecerus fasciculatus*, *Neana lifuana* and an unidentified lepidopterous pest. A section is also devoted to the diseases of shade trees used in coffee plantations.

459. DAVIES, R. M. 632.76 : 633.73
 The control of white stem borer of coffee.
E. Afr. agric. J., 1937, 2 : 293-7.

By the control methods advocated in Tanganyika in a block of 31,000 coffee trees the number of adult borers, *Anthores leuconotus* Pasc. caught was reduced from 5,014 to 28 and the number of larvae from 41,397 to 390 in 4 seasons. The methods consist chiefly of hand picking.

460. JACK, H. W. 633.855.334
Arecanuts.

Agric. J. Fiji, 1936, 8: 31-5, bibl. 3.

The arecanut has considerable economic value, the shipments to India from Malaya alone amounting to an annual value of £700,000. The palm, *Areca catechu* L., is raised from seed and in favourable conditions will bear in about 5 years. Self pollination is normally precluded by the sequence of the male and female phases. The fruit is ripe in 6 or 7 months and a normal crop for a grown palm is 3-4 bunches, each bearing 100-250 fruits of a bright orange colour and the size of a hen's egg. The average weight of product per palm is 4 lb. There are about a dozen varieties. Nuts are prepared for export in 3 forms—splits, wholes and sliced. In each form there are grades of quality and the characters by which the samples are classified are described for each form. Curing may be by air or sun drying except for slices, but for the best quality product artificial heating is used. The somewhat primitive methods are described. The commercial prospects of an extension of its cultivation in Fiji is discussed.

461. MANN, C. E. T. 633.912-1.56
The tapping of budded trees.*

Quart. Circ. Rubber Res. Scheme, 1936, 13: 121-36.

The manner in which budded trees differ from seedling trees is discussed. The differences largely lie in trunk shape and bark thickness and structure and have an important bearing on tapping procedure. A system of tapping for budded rubber is explained and recommended.

462. SINGH, B. N. AND OTHERS. 634.1/8: 581.192
Ontogenetic drifts in the physiology and chemistry of tropical fruits under orchard conditions.

Indian J. agric. Sci., 1937, 7: 176-92, bibl. 10.

The natural drift of metabolic changes in developing fruits of Krishnabhog and Langra mango and guava at different growth stages has been studied with a view to subsequent correlation with storage behaviour. Growth rate increases during the earlier stages and gradually declines with age. With the Krishnabhog variety, however, there is a subsequent slight rise in the sixth week. The respiratory index of the fruit shows 2 maxima, one during the early the other during the senescent stage. At all stages of development respiratory drift runs fairly parallel to the percentage of reducing sugars. It was experimentally shown that the decline in respiratory activity is due to hindrance of the gaseous exchange through the hard endocarp and the fleshy mesocarp. An inverse relationship is indicated between the acid contents of the fruit and the respiratory quotient. A decrease in the hydration factor results in an increase in the osmotic values of the sap due to the increasing sucrose content. This increase has a pronounced effect on the senescent drift, which in fact may be prolonged by maintaining the water content of the fruit at a steady level. The starch content of mangoes rises for the first 49 days, the subsequent decrease being probably caused by the hydrolysis of starch into sucrose. The nitrogen contents fluctuate in the same direction as the respiratory index. There is a positive correlation between nitrogen content and growth rate of the fruit. The C/N ratio is low at first and rises with age. The pH values run in a direction opposite to those of total acidity, attaining a maximum towards the onset of the climacteric. The fall of the acid content is accompanied by the hydrolysis to sugars of the starch stored during acid accumulation. The life cycle of the mango is divided into four stages each characterized by certain specific physiological and chemical changes—juvenile between 7-21 days, adolescent 21-49 days, climacteric 49-77 days, senescent 77 days.

* Lecture given at the Annual Conference of the Incorporated Society of Planters, Kuala Lumpur, October 1936. Reprinted from the special Conference Number of *The Planter*, October 1936.

463. STEPHENS, S. E.
Some tropical fruits. 11. The sour sop.
Qd agric. J., 1936, 46: 409-12.

634.411

The sour sop, *Anona muricata* L., is of frequent occurrence in the gardens of N. Queensland. The tree and its foliage, flower and fruit characteristics are briefly described. The fruiting season in the Cairns district lasts for several months. The small proportion of flowers which set fruit—12 to 20 fruits are usually considered a good crop for one tree—is regarded as one of the chief drawbacks to commercial cultivation in some countries. The tree thrives best in rich, loamy soil under the moist, humid conditions found in the tropical coastal wet belt. It may respond to applications of NPK fertilizer. Seed, sown in moist, shaded situations, germinates readily and is the common method of propagation. Vegetative propagation should, however, be adopted if a particularly desirable type is found, and for this purpose shield budding, which has been found successful by P. J. Wester, is suggested.* Nicotine sulphate and soap spray may be used to control the mealy bug which is the chief insect pest attacking the sour sop.

464. STEPHENS, S. E.
Some tropical fruits. 14. The star apple.
Qd agric. J., 1937, 47: 202-4.

634.433

Only one specimen of the star apple, *Chrysophyllum Cainito* L., is known to the writer in N. Queensland. The principal botanical characters of this tree are described. Seed is the common method of propagation and this germinates best when sown in light sandy soil. P. J. Wester has, however, demonstrated that shield budding may be successfully practised by using non-petioled budwood, cutting the buds $1\frac{1}{2}$ to 2 in. long and inserting them in that portion of the stock having a similar appearance to the scion. Well-ripened cuttings are also reported to root successfully if bottom heat is used.*

465. JULIANO, J. B.
Embryos of carabayo mango (*Mangifera indica* Linn.)
Philipp. Agric., 1937, 25: 749-58, bibl. 12.

634.441: 581.3

The carabayo mango (a variety of *M. indica*) has a normal embryo sac and an endosperm of the nuclear type. The zygote persists in the embryo sac a long time before dividing and forming sexual embryo, or it may degenerate without taking any active part in the production of any embryo in the seed. The asexual embryos in the seed are of nucellar origin and arise from active divisions of the epidermal nucellar cells round the micropylar end of the embryo sac. It is not possible to distinguish the sexually produced embryo from the asexual ones even in immature seed and the chances of there being sexual or no sexual embryo in the mature seeds of this variety are about equal, nor can it be said with certainty that on germination the sexual embryo shoot will be larger than the asexual ones. Some supposed cases of reversion to polyembryony by monoembryonic, imported Indian mangoes and the probable causes are discussed.

466. STEPHENS, S. E.
Some tropical fruits. 12. The cochin-goraka.
Qd agric. J., 1936, 46: 523-6.

634.47

The cochin-goraka, *Garcinia Xanthochymus*, a native of S. India and Malaya, was introduced to N. Queensland many years ago, where it became established without difficulty. The growth of the tree, its foliage and fruit are described briefly. It possesses an ornamental value, but has not been a great success as a fruit tree despite heavy cropping under suitable conditions.

* See also Vegetative propagation of tropical and sub-tropical fruits. *Tech. Comm. Imp. Bur. Fruit Prod.*, 7, 1936, pp. 21 and 27.

The tree thrives on various soil types, but appears to do best on low-lying alluvial soil, well-drained but with a fairly high moisture content. Propagation* from seeds is easy, and these will germinate most readily, if sown in a bed of leaf mould kept well moistened and shaded.

467. STEPHENS, S. E. 634.48

Some tropical fruits. 7. The five corner. 8. The cucumber tree.

Qd agric. J., 1936, 45: 270-1 and 397.

Both sweet and sour types of the five corner, *Averrhoa Carambola* L., are found in N. Queensland. The fruit of the former is usually eaten fresh while that of the sour type is more suitable for jellies or pickles. The tree prefers rich, deep soil and a moist climate, but can be grown under other conditions. Although only a small percentage of seed appears to be fertile, propagation is usually by this method. P. J. Wester in the Philippines has also found that the tree may be shield budded and recommends the selection of petioled budwood, ripe, smooth and purple in colour, the buds to be cut 1 to 1½ in. long.* The fruit of the cucumber tree, *Averrhoa Bilimbi* L., is used chiefly for pickling. Cultural requirements are similar to those of the five corner. Shield budding is again reported by Wester to be successful, and he advises the use of non-petioled, ripe budwood of brown colour, the buds being cut 1½ to 2 in. long.*

468. BOSWELL, J. G. 634.575: 581.192

Constitution of certain nutshells. I. The seed-coat of *Bertolletia excelsa* (Brazil nut).

Biochem. J., 1936, 30: 971-6, bibl. 6.

The author describes the technique used by himself on the seed-coat of the brazil nut and discusses his analytical data especially in comparison with those obtained on the hull of the pea nut (*Arachis hypogea*) by Emley in 1928. He states that this is the only other instance of work on the constitution of nutshells.

469. CLARKE, W. C. 634.58

The close planting of ground nuts.

E. Afr. agric. J., 1937, 2: 380.

The importance of close planting of ground nuts in reducing the incidence of rosette disease and increasing the yield is pointed out. Suitable planting is 30 lb. to the acre and a good method is to plant on ridges, 2 rows to a ridge, the seeds being set 12 in. apart in the row, for trailing varieties, and 3 rows per ridge 8 in. apart in the row for the erect kinds. This closer space still allows of the interplanting of early maturing maize.

470. ADRIAENS, L. 634.6: 581.192

Étude chimique de deux graines de palmiers du Congo Belge. (Chemical study of the seeds of two palms of the Belgian Congo.)

Bull. agric. Congo belge, 1936, 27: 456-71.

The palms are *Borassus flabellifer* L. var. *aethiopicum* Warb., an African form of the Palmyra palm and *Hyphaene guineensis* Schumacher and Tonn, a relative of the doum palm. This *Borassus* is very widely distributed in Africa, yet from the chemical standpoint there is practically no information on it. The author reports briefly upon the chemical composition of the separated shell and kernel of *Borassus* and more fully upon the carbohydrates of the kernel. These consist mainly of mannose and glucose, with a small amount of saccharose. The precise distribution of the *Hyphaene* is not well defined. The tree is widely used by natives of the Belgian Congo, but again not much is known of its chemical constituents. These have now been examined and a particular study made of the fats and fatty acids and of the carbohydrates.

* See also Vegetative propagation of tropical and sub-tropical fruits. *Tech. Comm. Imp. Bur. Fruit Prod.*, 7, 1936, pp. 35, 23, 24.

The fatty acids were found to comprise 45% unsaturated acids, mainly oleic acid, and 55% saturated acids, of which the chief is lauric acid with palmitic, myristic, stearic and other acids in lesser amounts. The carbohydrates are mannose and glucose, the former predominating.
H.S.

471. MASON, F. R. 634.61
The coconut industry on the Malabar Coast of India.
Malay. agric. j., 1936, 24 : 476-84.

The coconut industry on the Malabar Coast is based on smallholders' crops, the average size of a holding being under 2 acres. The method of disposal varies. In some parts the entire crop is sold in the form of nuts to dealers, while in others the majority of nuts are made into copra either by the smallholders or by professional Mohammedan dealers. Further, the coir industry is extremely important and hardly a husk is wasted on the Malabar Coast. The following processes are described : retting, skinning and beating, twisting or spinning, grading and baling. Notes are given on the approximate costs of the different operations. There is a Government Research Station at Kasaragod, South Kanara, covering 30 acres. It was a coconut garden until taken over by Government in 1916. There individual palm records are kept in all blocks, but only palms in the centre of a block are used for recording, the outer rows acting as guard rows. Selection work is in progress, palms being selected for the following characters :—high yield, high production of female flowers, high setting of fruit, thick meat and large nuts. The ultimate aim is to select nuts for planting by the study of morphological characters. Individual palms on the station have given up to 150 nuts a year as against the average of 15 to 20 nuts on ordinary holdings. A full report on the work is promised in the near future.

472. RISBEC, J. 634.61-2.7
Les parasites du cocotier en Nouvelle-Calédonie. (Pests of the coconut in New Caledonia.)
Agron. colon., 1936, 25, No. 221, pp. 140-52 and No. 222, pp. 169-88.

Descriptions, accompanied by diagrams, are given of the following insect pests of coconuts in New Caledonia, together with accounts of their life histories, the injury they cause and recommended methods of control :—*Agonoxena* sp., *Tirathaba rufivena* Walk., *Aspidiotus destructor* Sign. and a hymenopterous parasite of this insect, *Aleurodicus destructor* Mack., *Aleurocanthus* sp., *Brontispa froggatti* Sharp, *B. sarasini* Heller, *Plesispa cocotis* Maulik. and *Calandra taitensis* Guérin. In addition, a short description is given of an unnamed fungus disease, and a note is added to the effect that the trees may be protected from the serious depredations of rats by placing zinc bands around the trunks. Bats are also accused of destroying the young nuts, but no practical means of preventing them doing so are known.

473. TAYLOR, T. H. C. 634.61-2.76
The biological control of the coconut leaf-miner (*Promecotheca reichiei* Baly) in Fiji.
Agric. j. Fiji, 1936, 8 : 17-21.

Describes how the coconut leaf-miner of Fiji was completely suppressed by the parasite *Pleurotropis parvulus* Ferr, introduced from Malaya.

474. FREEMAN, H. J. 634.62
Date culture in Queensland.
Qd agric. j., 1936, 45 : 376-96, 487-501, and 1936, 46 : 392-406.

This account of date culture has been written with a view to assisting the establishment of a date industry in the hot, mid-western districts of Queensland, where conditions have been found to be similar to those of other regions producing dates on a commercial scale. Sections

are devoted to the requirements of date growing areas, the botany of the date palm, propagation by means of offshoots, planting, irrigation and manuring, pollination, fruit thinning, the protection of fruit clusters from rain, harvesting, packing houses, and cleaning, grading, ripening and packing the dates. Most of the information given would appear to be based on American experience. A list with brief descriptions of about 12 varieties at present grown in Arizona and thought to be most suitable for planting in Queensland is given at the end of the article.

475. CASTELLI, E. 634.651.
The pawpaw (*Carica Papaya*) in Trinidad agriculturally and industrially treated.

Proc. agric. Soc. Trin. Tob., 1937, 37 : 61-75.

This is a suggestion for the establishment of an industry in Trinidad whereby the pawpaw may be processed for the manufacture of standardized dietetic products. It is proposed, not that a large acreage should be planted with pawpaw, which might prove unremunerative, but that a central factory and laboratory should be established, the fruit to be obtained by purchase from the peasants who would be encouraged to grow the tree in every available spare space. The production could thus be enormously increased without detriment to existing crops or danger of financial loss to the growers. It is pointed out that the establishment of such an industry in which all could participate would be of sociological as well as industrial importance and is essentially one in which financial aid might be expected from the Government until it became self supporting. [A special Committee of the Society is now examining the proposals.—ED.]

476. HOFMEYR, J. D. J. 634.651 : 575
Inheritance in the papaya. Progeny studies of selected parents.
Fmg S. Afr., 1936, 11 : 107-9, 126, bibl. 3.

The *C. Papaya* trees used in these studies belonged to the Ceylon variety and were closely related, since, although their paternity was probably different, they were all grown from seed from the same mother tree. Two outstanding staminate and four pistillate trees were selected for crossing. The flowers of the latter were bagged and were hand-pollinated with pollen from the two ♂ trees. The fruit characteristics of the progeny were subsequently studied and the data obtained are presented mainly in diagrammatic form. As regards size of fruit one of the two ♂ parents produced progeny with distinctly larger fruit than did the other when crossed with each of the four ♀ trees. No such striking differences were apparent in thickness of the fruit flesh, and, if anything, there was a tendency towards thicker flesh in the smaller fruit. Shape of fruit was compared in the progeny of two ♀ trees pollinated by the same ♂ tree, and a distinct difference was again apparent. The shape of the seed-cavity of the fruit was also found to be influenced by the ♂ parent employed. These results are considered to illustrate the importance of both ♂ and ♀ parents in the transmission of desirable or undesirable qualities to their respective progeny. A full account of this experiment is to be published elsewhere in the near future.

477. KERNS, K. R. AND OTHERS. 634.774 : 581.144/5
Developmental studies of the pineapple (*Ananas comosus* (L.) Merr).
I. Origin and growth of leaves and inflorescence.
New Phytol., 1936, 35 : 305-17, bibl. 4.

The authors describe in detail and with microphotographs their observations made in 1934 and 1935 on the origin of new leaves during vegetative reproduction in the pineapple and the phenomena involved at the apex of the plant during the transition from leaf production to the formation of an inflorescence. The following notes are taken from their summary :—The first visible evidence that an inflorescence is to be formed is the increase in size of the meristem area at the apex of the plant axis. The inflorescence begins development before the peduncle starts elongation. The phyllotaxy of the large fruited varieties is 5/13 for the plant and for the fruit

8/21. Small fruited varieties have a 3/8 plant phyllotaxis and 5/13 for the fruit. The time when the phyllotaxy changes from that of the leaf-producing growing point to the inflorescence growing point is considered a critical one for the production of fruit and crown abnormalities.

478. GODFREY, G. H. 634.774-2.651.3 : 581.144.2

The pineapple root system as affected by the root-knot nematode.

Phytopathology, 1936, 26 : 408-28, bibl. 38.

This paper gives a detailed description of the symptoms produced on, and the changes induced in, pineapple root systems in Hawaii by varying populations of the nematode, *Heterodera marioni* (Cornu) Goodey, in the soil. The literature on the subject is reviewed. The normal pineapple root system consists of about 100 main roots of uniform size covered with branch rootlets. Experiments have shown that an infestation of at least 100 active larvae located directly at the tip of the root is necessary before the growth of a vigorous root is stopped and a gall formed, and secondly that an initial infestation of 100 larvae fairly uniformly distributed per cubic inch of soil is necessary to stop the growth of every primary root. Heavy initial infection results in dwarfed plant growth, greatly reduced yield and early failure of ratoons. Where initial infection is distinctly lighter the plants may become well established, but yields depend upon the extent to which the nematode population subsequently increases.

479. PALO, M. A. 635.646 : 632.48

The *Phomopsis* disease of eggplant and its control.

Philipp. J. Agric., 1936, 7 : 289-315, bibl. 8.

This fungus disease is caused by *Phomopsis vexans* (Syd. and Sacc) Harter, which attacks all parts of the plant, the symptoms being the formation of elongated sunken lesions, buff-brown or blackish brown in colour, after which the diseased parts rapidly shrink, flatten and decay. In older parts of the stem the wood frequently becomes exposed, the plant is girdled and dies. In this paper the symptoms of the disease on different parts of the plant stems, leaves, fruits and seedlings are described and illustrated. In the Philippines after a very severe outbreak in which every plant in a field of 7,000 was attacked, control in the case of subsequent plantings was obtained with a sevenfold increase of yield by six weekly sprayings of diseased plants with bordeaux mixture 4-4-50. Five fortnightly sprayings in a healthy field where there is danger of infection assist greatly in preventing successful infection. Other control methods suggested are disinfection of suspicious seeds in 1 : 1,000 corrosive sublimate solution for 10 minutes, or commercial formalin solution 1 : 300, soaking the seeds in hot water for 30 minutes at 50° C. or 10 minutes at 55° C., burning the plants in an infected field after harvest, and 3-year crop rotation.

480. WORSLEY, R. R. LE G. 632.951

The insecticidal properties of some East African plants. II. *Mundulea suberosa* Benth.

Ann. appl. Biol., 1936, 23 : 311-8, bibl. 8.

Mundulea suberosa bark shows considerable promise as a source of a powerful insecticide. Bark from trees in the Moa district of Tanganyika was found to be as toxic to insects as Amani derris root containing 5.4% rotenone, though bark from 2 other sources was not so toxic. Seed from Moa is being sown, and, if the trees can be readily grown, it is thought that the bark may become of commercial interest.

481. BECKLEY, V. A. 589.98 : 632.951

Pyrethrum drying.

E. Afr. agric. J., 1937, 2 : 327-8.

The construction of driers for *Pyrethrum* are discussed, and working plans and specifications for building the Ainabkoi drier are provided.

482. GEORGI, C. D. V. AND GUNN LAY TEIK. 632.951
Notes on the preparation of derris root for export together with a suggested method of evaluation.

Malay. agric. J., 1936, 24: 489-502, bibl. 4.

The authors describe recent experiments carried out with derris root mainly with the idea of standardizing the method of analysis. The following steps in analysis are considered at some length:—*Selection of sample.* The essential is that (a) samples must be drawn at regular intervals during the process of packing, and (b) a constant proportion must be kept between the amount of the sample and the quantity sampled. It should, preferably, not be less than $\frac{1}{2}$ % by weight of the material sampled. *Preparation of root for analysis.* This includes sun drying, cutting, weighing, disintegrating and grinding. *Determination of moisture.* The method recommended for individual samples is distillation with xylene, and for numerous samples drying to constant weight in the steam oven at 100° C. *Determination of ether extract.* 5 grams of finely ground root is treated in a Soxhlet extractor for 16 hours at a temperature just high enough to allow the solvent to boil gently. *Determination of rotenone.* The process adopted in the Agricultural Department of Malaya is described. It is based on one already published by the authors.* It uses carbon tetrachloride as a solvent but with the difference that the trituration of the crude carbon tetrachloride complex with cold alcohol as described by Cahn and Boam† replaces the method of recrystallization from boiling alcohol. A plea is uttered for the standardization of the process of rotenone estimation on a basis in which purity of product as judged by the present accepted standards would be unquestioned.

STORAGE.

483. IMPERIAL INSTITUTE, LONDON. 664.84 + 664.85
Notes on the storage of foodstuffs.
E. Afr. agric. J., 1937, 2: 349-53, bibl. 9.

The foodstuffs dealt with are cereals, beans, groundnuts, yams, cassava and sweet potato. *Beans.* These should be dried, to reduce moulds, using artificial heat if necessary, and treated against bean weevil when ready for storage. Methods are to place the seeds in boiling water, drain this off immediately, and dry the seeds thoroughly, or to fumigate for 48 hours in an airtight chamber using carbon bisulphide, 1 oz. per 100 lb. of seed. Temperatures below 60° F. require a stronger dose. A third method is to heat the beans to 145° F. or higher. *Groundnuts.* Unshelled nuts stored in sacks or cribs in a well-ventilated dry store and protected from rats and mice will keep well for long periods. *Yams.* These store best when arranged on shelves in layers 3 or 4 ft. deep, or in small heaps on the floor of well-ventilated rooms, or less satisfactorily in pits dug in ground which is dry and will continue so. Bruised tubers rapidly deteriorate and should be treated with bordeaux or slaked lime. *Cassava.* Tubers do not store well after exposure to the air. Chips, however, prepared by peeling and slicing and subsequent sun-drying till crisp will keep for a long period. The chips are prepared for use when required by pounding and sieving to separate the fibre from the flour. *Sweet Potato.* Careful handling is essential owing to the thin and delicate skin. The most satisfactory method out of many tried experimentally consists in storing in clamps or pits with or without ventilation. Decay in these conditions is low and shrinkage is a frequent form of deterioration. In U.S.A. special sweet potato storage houses are used. The potatoes when lifted undergo a curing process in a temperature of 80° F.—85° F., at a relative humidity of 90% with sufficient ventilation to prevent condensation of moisture for a period of from 10 days to 2 weeks. The temperature is subsequently maintained at 55° F. with a relative humidity of 85-90%. The high humidities are regarded as an important factor in checking shrivelling and internal breakdown.

* The valuation of tuba root. *Special Bull. Sci. Series*, No. 12, 1933.

† Cahn, R. S. and Boam, J. Determination of rotenone in derris root and resin. *J. Soc. Chem. Ind. Lond.*, 1935, 54: 8, 37T.

484. SINGH, B. N. AND MATHUR, P. B. 664.85.035.1
An adaptation of Haldane's gas-analysis apparatus.
New Phytol., 1936, 35 : 418-22, bibl. 6.

In the course of investigations on the gas storage of tropical fruits Haldane's apparatus has been slightly modified so as to render it convenient for R.Q. measurements in plants. The slight changes introduced are described with diagrams and the manipulation is detailed.

485. DAVIS, M. B. AND BLAIR, D. S. 664.85.11.037
Cold storage problems with apples.
Sci. Agric., 1936, 17 : 105-14, bibl. 6.

Since maturity plays an important part in the keeping performances of apples, the maturity tests are briefly mentioned. The two most useful are the ground colour and the iodine tests, the latter being described and illustrated. Cold storage spoilage is classified under 4 headings : (1) *Loss from rots or fungal invasion*. McIntosh and Fameuse apples at Ottawa were infected by 4 types of rot, of which *Penicillium* spp. and *Alternaria* spp. were by far the most prevalent. Rot development was markedly correlated with storage temperature, total loss being almost negligible at the lower temperatures (32° F. and 30° F.). The fact that fruit grown under high nitrogen conditions is more subject to rot than fruit from low nitrogen areas may be an indirect effect of softer fruit, which is more readily bruised in handling. (2) *Loss from shrinkage*. This is due to two causes, namely the rate of respiration controlled by temperature and atmosphere and loss by evaporation, transpiration or desiccation controlled by the relative humidity of the store. At temperatures of 30° F. and 32° F. loss is small, if the relative humidity is held at 85-90%, but at 40° F. high relative humidities do not control shrinkage, a fact which indicates that the respiration rate is of primary importance. (3) *Loss from apple scald*. With McIntosh and Fameuse immaturity at time of storage is the greatest contributing factor to the development of scald. A general statistical treatment of the effect of temperature on scald development shows significantly higher percentage development at 30° F. and 32° F. than at either 36° F. or 40° F. (4) *Loss from physiological decay* (shown in brown heart, core flush or Jonathan type breakdown). Several factors enter into this most important source of storage loss. (a) *Influence of maturity*. A close correlation was established between immature McIntosh and premature core-flush development, especially at storage temperatures higher than 32° F. In Fameuse, however, there was no such correlation. (b) *Influence of delayed storage*. Core-flush development apparently is more pronounced when the fruit is cold stored just at its climacteric. Immediate storage of fruit picked at the proper stage of maturity is advised and a caution is given against cold storage of McIntosh and Fameuse which have been held at higher temperatures for more than 48 hours. (c) *Influence of temperature*. With Fameuse 32° F. is the optimum storage temperature which seems to neutralize differences in keep due to other factors, but with McIntosh the optimum temperature is from 36° F. to 40° F. for most samples, although certain lots which have remained trouble free at 32° F. have retained crispness and quality much longer than most at the higher temperatures. (d) *Influence of nutrition*. A brief review of the literature is given. In the author's experiment a Fameuse orchard showed improved keeping quality at 36° F. and 40° F. after nitrogen had been applied to a section under sod, but reduced keeping quality after nitrogen in a section under mulch. When a section under sod received both nitrate of soda (6 lb. per tree) and superphosphate (3 lb. per tree) the keeping quality at 36° F. and 40° F. was entirely destroyed, whereas on the mulched section the keeping quality was improved. There is an indication here of the nitrogen/phosphorus relationship affecting keeping quality, and this is supported by other evidence. The value to keeping quality of nutritional balance is emphasized, long time fertilizer experiments at Kentville N.S. having shown that in the long run a complete fertilizer of 9-5-7 is more satisfactory than single or two element applications. *Gas storage*. McIntosh apples gas stored at 40° F. under 7.5% CO₂ concentration (if wrapped in oil paper) kept with the minimum of spoilage and with less shrinkage and loss of flavour and crispness than at 32° F. The importance of wrapping in oiled paper is shown by the fact that unwrapped McIntosh under the above

conditions developed scald on removal after 2 months in gas store, and after 5 months all the unwrapped ones either in or out of store had developed scald, whereas the wrapped apples were entirely free from it.

486. SUTHERLAND, R. 664.85.11.037
Results of cold storage investigations of factors in the prevention of wastage in Cox's Orange Pippin apples.
Orchard. N.Z., 1936, 9 : 215-9.

A series of investigations was carried out during the four years 1932-5 to determine the influence of a number of factors on the incidence of bitter pit, internal breakdown and fungal rotting in Cox's Orange Pippin apples, held in cold storage for periods equivalent to those occupied in transit to overseas markets. *Influence of locality and soil types.* Samples of fruit were taken from trees growing in light loam and heavy soils in each of five localities. Bitter pit and internal breakdown were found to vary in their incidence in apples from different districts, but in each locality the samples from the clay soils showed a higher incidence of both disorders than did the samples from the light soils. There was no relation between fungal rotting and soil type. *Influence of maturity at the time of picking.* The incidence of bitter pit was greatest in apples picked when immature and became progressively less, the more mature the apples were when harvested. On the other hand susceptibility to internal breakdown and fungal rotting became more pronounced in the more mature apples picked late in the season. *Influence of transport temperatures.* Significantly less internal breakdown occurred in apples stored at 37° F. than in apples kept at 34° F. This applied equally to the two counts 216 and 180, there being very little difference in the amount of wastage in the two sizes. *Influence of packing pads on bruising.* One-piece corrugated wraps used for lining cases afforded apples more protection against bruising than did one-piece plain cardboard wraps, corrugated wraps top and bottom of the case only, or no packing pad. Ripe apples were found to be more subject to bruising than less mature fruits, irrespective of the packing pad used. *Effect of packing method on bruising.* Apples packed to give a raised flat surface and then pressed by the lidding press to form a bulge were more bruised than apples packed so that the crown formed a bulge prior to lidding.

487. KIDD, F. AND WEST, C. 664.85.11 : 634.11
The keeping qualities of apples in relation to their maturity when gathered.
Sci. Hort., 1937, 5 : 78-86.

The main phases through which an apple fruit passes from the bud stage to final decay are briefly outlined. The critical portion of the life cycle from the point of view of harvesting lies in England for Bramley's Seedling (and for many other varieties) between mid-September and mid-October, the dates varying according to the weather conditions prevailing during the summer and early autumn. During the interval under consideration a definite increase in weight, averaging from 5-10% may occur; this gain may be offset by loss from the high winds to be expected at this time of year. Immature apples shrivel in storage more rapidly than mature fruit. Quality, i.e. characteristic taste and colour is enhanced by a lengthened period on the tree. The more mature the fruit when placed in cold or gas storage, the more rapidly fungal wastage, breakdown and scald of the senescent type develop. The earlier apples are gathered, the more liable they are to superficial scald in storage. Experiments show that fruit kept at ordinary temperatures for some time before cold storage developed much less scald than fruit stored during its climacteric rise in respiratory activity, while fruit placed in cold storage after the climacteric did not scald. In most cases, however, this trouble can be controlled by the use of oiled wrappers. Low temperature breakdown occurs more quickly when the apple is placed in cold storage at the peak of the climacteric than if so stored before or after this stage. The volatile products of post-climacteric apples have been found to induce the onset of the climacteric in pre-climacteric fruit. Experiments demonstrating this are described in detail. In practice this means that ripe fruit stored with unripe fruit especially

under gas storage conditions may stimulate the ripening and therefore, shorten the storage life of the unripe fruit. The broad fact that immature fruit of Australian and New Zealand apples is more likely to develop bitter pit than fruit gathered later has been established, but the same effect has not been observed with English fruit. In gas storage the interval between picking and sealing the fruit should not exceed five days, so that it can be certain that no apples have reached the climacteric which the gas storage is intended to suppress or delay. The effect of the carbon dioxide in the storage atmosphere will be largely vitiated, if the fruit has reached the climacteric before storage. A consideration of all the factors concerned would indicate that the most suitable time to gather apples for storage is during the fortnight prior to the beginning of the climacteric phase. A fairly reliable index of this stage is, when the fruit can just be detached by gently twisting it on its stalk. Fruit picked before this stage can be safely gas or cold stored for not more than 3 months. Fruit picked after the climacteric is suitable only for immediate marketing.

488. BATCHELDER, E. L. AND OVERHOLSER, E. L. 634.11 : 577.16

Factors affecting the vitamin C content of apples.

J. agric. Res., 1936, 53 : 547-51, bibl. in text.

Studies were made of several factors in relation to their effect upon the vitamin C content of apples. The effect of ratio of leaf area to fruit was examined in Delicious apples growing on large, unringed branches and Winesap apples growing on ringed branches. Fruits were thinned in early July to leave ratios of 60 and 20 leaves per fruit in each case. Practically no difference was observed between Delicious apples grown at the two leaf-fruit ratios when radial sections of the fruits were fed to guinea pigs, but, in the case of Winesap, apples grown at the low ratio possessed a higher vitamin C content than those grown at the high ratio. This conflicting result is attributed to the fact that the fruits of both lots of Delicious apples were of similar size, whereas the low-ratio Winesap apples were distinctly smaller than the high-ratio fruits. It is concluded that the leaf-fruit ratio affected the vitamin C content of apples only indirectly, i.e. only in so far as it affected the size of the fruit produced. The fact that small Winesap apples contained, weight for weight, more vitamin C than large apples was demonstrated by feeding 8-g. radial sections of both to guinea pigs. The higher vitamin C content occurred in the small apples because they possessed a higher ratio of skin to pulp than did large fruits and the skin contained a higher concentration of vitamin C than the pulp. When large and small Winesap apples from high and low leaf-fruit ratio branches were sampled by removing each section of skin with $\frac{1}{4}$ in. of pulp attached, so as to give equal proportions of skin and pulp, the concentration of vitamin C present was approximately the same in each case. Finally it was found that storage of Winesap apples at 40° F. for 6 months resulted in greater losses of vitamin C than did storage at 32° F.

489. RUDRA, M. N. 577.16 : 581.192

Distribution of vitamin C in different parts of common Indian foodstuffs.

Biochem. J., 1936, 30 : 701-3, bibl. 6.

The author tabulates the results of his examination for vitamin C of some 20 vegetables or fruits commonly used in India. He found that this vitamin is more concentrated in the skin of fruits and vegetables than in the ordinarily edible part. In root vegetables it is most highly concentrated in the leaves.

490. LEVY, L. 634.441 : 577.16

Antiscorbutic value of South African mangoes.

Fmg S. Afr., 1937, 12 : 90, bibl. 10.

The vitamin C contents of some 14 types of S. African mango were calculated by the 2 : 6-dichlorophenolindophenol titration method. As S. African mangoes are with very few exceptions seedlings, only varieties which commonly come true to type were examined. The results are tabulated and compared with values obtained in other countries. With the exception of two types, Sabre and Br. 2 (Mulgoba), the values found compared unfavourably with those of

foreign varieties, the discrepancy between the ascorbic acid contents of Alphonse varieties grown in India and S. Africa being particularly marked. The results also indicate that the concentration of vitamin depends on the variety rather than on the size of the fruit.

491. WITT, N. F. AND POE, E. E. 634.22 : 577.16

Vitamin G content of prunes.

Fruit Prod. J., 1936, 15 : 274-5, 283, bibl. 9.

The five samples of prunes tested for vitamin G were grown in California. The moisture content of each sample was determined, and the prunes were fed undried in various amounts to rats. The average vitamin G content per pound was 558.8 units for the undried samples and 807.4 units on the basis of water-free samples.

492. CHEEMA, G. S. AND OTHERS. 664.85.31.037

The cold storage of Nagpur oranges (*Citrus Aurantium*).

Indian J. agric. Sci., 1937, 7 : 168-75, bibl. 18.

A report is made of the cool storage behaviour of Nagpur oranges in the green, the turning and the yellow stages. The fully ripe yellow orange kept in good condition with little wastage for 3 months at 40° F. Green and turning fruits changed to yellow but lost their juice at 45° F. and 52° F. Discolouration of the stem-end, due to the development of dark-button, was specially marked in green and turning fruits in the beginning of storage life, and leaving half an inch of stalk on each fruit did not act as a check to its development. Internal breakdown developed after varying periods of storage in fruits at all stages held at 35° F. and 40° F. but only rarely at 45° F. and 52° F. At 45° F. and 52° F., however, there was appreciable *Alternaria* wastage. Storage life was not lengthened by pre-storage antiseptic treatments.

493. GANE, R. 634.771 : 581.12

A study of the respiration of bananas.

New Phytol., 1936, 35 : 383-402, bibl. 13.

The experimental fruit, generally the Gros Michel variety, was obtained from the local depot within 2 or 3 days of unloading at Avonmouth. The author graphs his experimental data on the respiration of bananas, and gives a diagram of the apparatus used to measure it in gas mixtures. He summarizes as follows:—"1. The respiration of unripe bananas has been measured at temperatures of 12.5, 15, 20, 31 and 32° C. The values lie near a smooth curve for which a mathematical expression has been found ; $\log R' = 0.843 + 0.0348\theta$. The temperature coefficient of respiration Q_{10} , between 12.5 and 20° C., is 2.23. 2. The time of duration of the climacteric is an exponential function of temperature. 3. Injury to the fruit occurs at high temperatures (31° C. and above) and may be prevented, if the exposure is not too long, by storing in an atmosphere with an increased concentration of carbon dioxide. 4: Short exposures of the fruit to low temperatures quickly reduce the rate of respiration to a lower level which is then maintained during the exposure : when returned to the higher temperature, recovery is rapid and complete. 5. The anaerobic production of carbon dioxide by bananas at 15° C. varied with the degree of maturity of the fruit. In pre-climacteric fruit the anaerobic production of carbon dioxide is the same as the aerobic for a short period, after which there is a steady fall, which in 20 days reaches almost zero. At or after the peak of aerobic activity, the anaerobic rate is much lower than the aerobic rate and falls steadily. 6. The respiration in a gas mixture consisting of 10% oxygen, 10% carbon dioxide and 80% nitrogen is reduced to 80% of the value in air ; with one sample under these conditions the climacteric was delayed and did not occur within the period of the observations. 7. Respiration during the climacteric is related to the concentration in the pulp of total soluble sugars and to sucrose. The relation between them is expressed by a rectangular hyperbola. 8. The pH of the pulp decreases during and after the climacteric, and reaches a minimum value when the fruit has developed its full yellow colour. After this stage there is a slow increase. 9. The total volatile substances produced by the fruit have been determined as carbon dioxide by combustion. The quantities obtained were extremely small until the fruit reached an 'over-ripe' stage."

494. SAN PEDRO, A. V. 664.85.669
Studies of the storage-temperature requirements of lanzones (*Lansium domesticum* Correa).
Philipp. Agric., 1936, 25 : 411-51, bibl. 27.

An apparatus for extracting the juice of plant materials and for determining the freezing point of the juice is described. There was a significant difference in the freezing point of juice of the lanzon (langsats, duku) extracted from unfrozen and from previously frozen tissues. The average freezing point of juice from frozen lanzones was -1.672°C. , and the larger the fruit, the lower the freezing point. No significant differences were found in the freezing points of the juice from stem, median and stigmatic regions of the fruit. Green and turning fruit in storage failed to ripen even at 27° – 31°C. At these temperatures covering the fruit with sawdust prolonged its life to 7 days instead of 3. At 13° – 15.5°C. , the most suitable storage temperature, ripe lanzones kept for 13 days with a wastage of 9.48%, part of which could have been avoided by more careful picking. Immediate storage reduced fruit spoilage by $\frac{1}{3}$ to $\frac{2}{3}$ compared with fruit held for 2 days at room temperature (in this case 27° – 31°C.). At storage temperatures below 13°C. fruit browned externally and presented a water-soaked appearance. At 16° – 18°C. the rate of decay was much faster than 13° – 15.5°C. The rate of carbon dioxide output decreased with advancing maturity. At 0°C. there was a decline in CO_2 output in fruit of all stages of maturity; there was no decline in respiration at 10°C. , 20°C. and 27.5°C. , but respiration rate increased with the temperature. The catalase activity of the rind of turning fruits was a little above that of green fruits, while that of ripe fruit was about $\frac{1}{3}$ to $\frac{1}{2}$ as active as that of turning fruit. At 13° – 15.5°C. there was little change in dry matter and total sugars, an increase in specific gravity and reducing sugars and a decrease in titratable acidity. These changes indicate the general suitability of this temperature for storing lanzones.

495. HARVEY, R. B. AND OTHERS. 635.61 : 664.85.037
Extending the use of melons by frozen storage.
Fruit Prod. J., 1936, 15 : 146-8.

It has been found possible to store whole or diced muskmelon, honeydew and watermelon for eight months at 0°F. A number of recipes are given for using the frozen melons in ice creams, cocktails, etc.

496. APPLEMAN, C. O. AND SMITH, C. L. 664.84.037
Effect of previous cold storage on the respiration of vegetables at higher temperatures.
J. agric. Res., 1936, 53 : 557-80, bibl. 18.

Experiments were made in Maryland to determine the respiratory responses at 22°C. of the following vegetables after various periods in storage at 2.5°C. Potatoes, sweet potatoes, beets (*Beta vulgaris* L.), turnips, parsnips, carrots and onions. The response of dahlia roots was also investigated. In addition to the respiratory responses after cold storage the relationship between respiratory intensity and age of the various vegetables was studied, and attention was also paid to the relation of the carbohydrates and moisture in the vegetables to their respiratory intensity under different conditions, especially after cold storage. The experimental procedure used is described, and the proper basis for calculating respiration data is discussed. Further proof of the respiratory production of excess CO_2 by potatoes following removal from cold storage was obtained. This excess output is only temporary, and it has been shown that a similar initial response can be reproduced in the same lot of potatoes at least three times over a period of five months. The effect of previous cold storage on the initial respiration rate of other vegetables at higher temperatures varied greatly with the species. Whereas the response was very pronounced in potatoes, sweet potatoes and dahlia roots, and still distinct, though much less marked, in beets and turnips, it was not detectable in carrots and onions. The vegetables in

which the percentage of starch was relatively high and in which there was a rapid shifting of the carbohydrate equilibrium with temperature changes showed the greatest increase in initial respiratory rate when transferred from a low to a higher temperature. The actual respiratory intensity in these vegetables, however, was lower than in most of those showing smaller change-of-temperature responses. The time rate of respiration in potatoes, sweet potatoes, parsnips, onions and dahlia roots declined rapidly immediately after harvest, and then more slowly until it began to fluctuate around a fairly constant average rate for the remainder of the respiration period. In carrots, beets and turnips, on the other hand, the respiration rate declined steadily until the end of the respiration period. The experiments have shown that the sugar which accumulates in starchy vegetables at low temperatures is not responsible for the initially high respiration in these vegetables when transferred to higher temperatures. The shifting equilibrium between sugar and starch in potatoes tends to attain stable positions with widely different percentages of sugar characteristic of different temperature ranges. Potato tubers accumulated almost as much sugar for a time at 29° C. as at 0° C., but this accumulation at the high temperature did not affect the respiration rate. There was no direct correlation between the content of either total or reducing sugars and the respiration rate in the vegetables studied.

497. WHITE-STEVENS, R. H. 664.84.53
Analytical observations on the changes of pectic substances and sugars in celery during cold storage.
Sci. Agric., 1936, 17 : 128-36, bibl. 9.

An attempt has been made to correlate storage maturity with pectin and sugar changes of celery in cold storage at 32° F. A detailed technique for the quantitative comparison of the different pectic constituents is given. There appears no definite correlation between pectic hydrolysis and storage maturity, apart from the cytolytic effects of storage pathogenes. Sucrose sugars show a marked increase in the early stage of the storage period, ultimately declining with a simultaneous increase in hexose, which in turn reaches a maximum and then likewise declines. Assuming sugar content to be a major property of food value in stored celery it would seem that the optimum duration of celery in cold storage at 32° F. is approximately between 60 and 100 days, after which its food value declines rapidly. This is but a generalization for it is possible that such factors as variety, cultural treatment, time of planting and harvesting may affect the loss of sugars markedly. [Author's summary.]

498. BISSON, C. S. AND OTHERS. 664.84.656
Determining changes in stored peas by use of a reference element.
Hilgardia, 1936, 10 : 143-65, bibl. 5.

The presentation of the results of analyses as percentages of dry matter to indicate changes in stored materials is criticized on the ground that it does not provide a true picture of the absolute changes that take place, since the variables studied are compared with total dry matter which is itself a variable. In the studies reported here the authors have determined the absolute changes occurring in both pods and peas in storage and the transfer of material from one to the other. To do this it was necessary to find some element which does not undergo any change in absolute amount during storage, and to use this as a reference weight with which to compare those compounds which do undergo changes during storage. In previous tests phosphorus was found to be the most consistently uniform in percentage composition and this element was chosen as the basis for calculating the absolute weights of the various components. The methods of calculation are described in detail. Both peas and pods were stored in shelled and unshelled series at temperatures of 3.5° C. and 25° C. Determinations of dry matter, carbon, total sugars, starch, crude fibre, nitrogen, phosphorus and magnesium were made at intervals up to a maximum storage period of 188 hours, and the results obtained are tabulated and described separately for each constituent.

PACKING, PROCESSING, FRUIT PRODUCTS.*

499. RAPHAEL, T. D. 634.11-1.564
Notes on the bulge and shrinkage in Canadian type fruit cases.
Tasm. J. Agric., 1936, 7: 157-9.

Maximum bulge measurements at both tops and bottoms were taken in Tasmania and again in England of a consignment consisting of two apple varieties packed in 6 cases constructed of pine timber, 6 of hardwood and 6 with hardwood sides and ends and pine tops and bottoms (so-called "shandy" cases). The bulges in the hardwood cases ranged from 2 to 3 cms. and in the pine cases from 3 to 5 cms. Bulge contractions averaged 68% for pine, 41% for "shandy" and 38% for hardwood. Very few cases were reported to have arrived in slack condition, but it is thought that this fault would have been much more apparent in the hardwood cases had they been given a larger bulge. Of the two varieties used in this trial and two others packed only in pine cases, French Crab showed the least shrinkage or settlement, Cleopatra was intermediate, and Scarlet and Cox's Orange showed a much reduced bulge on arrival in England. The factors responsible for the flattening out of bulges in different types of timber are briefly discussed. It is considered that no definite conclusions can be drawn from so limited a trial, except in so far as the results serve to stress the necessity for the selection of suitable timber and the adoption of the correct pack.

500. POMEROY, D. AND CRUICK, W. V. 634.63-1.56
Greek olive investigations.
Fruit Prod. J., 1936, 16: 11-3, 22, 43-4, 59.

The pack of Greek style olives has increased materially in recent years owing to the difficulty of utilizing surplus olives in other ways. There has, however, been a tendency for moulds to develop in the fruit during curing or in the final package, and investigations were, therefore, undertaken at the University of California during the 1935-6 season to discover the conditions under which mould develops in, or on, Greek olives and to find means of preventing its occurrence. The more important results of some 14 experiments are summarized in this paper. These were concerned with the effects of: (1) different types of salt, (2) wetting the olives before packing them in salt, (3) storing olives in brine before salting, (4) the amount of salt used, (5) sodium bicarbonate as affecting curing, (6) the dehydration of olives sorted in brine, (7) temperature as influencing the rate of curing, (8) washing and coating with olive oil after storing, (9) the temperature of curing as affecting mould development, (10) the amount of water necessary for mould growth, (11) the use of the Sevillano variety to make Greek olives, (12) lye treatment, (13) canning as affecting mould growth and quality, and (14) the rate of heat penetration in canned Greek olives.

501. QUINN, D. G. 664.85.22.047
Prune drying; seasonal notes.
J. Dep. Agric. Vict., 1937, 35: 71-3.

Stress is laid on the necessity of full ripeness before drying. It is best to let the prunes fall from the trees, since in the few days between the time when they can be shaken off the trees and the time when they drop naturally a rise of 11% in their sugar content occurs. Immature fruit is hard and tart, and its processing has created a definite "sales resistance" mentality in regard to dried prunes in a large body of potential consumers. Dipping in caustic lye hastens drying, but over dipping causes the fruit to turn musty on cooking. The caustic soda solution (1 lb. to 15-20 galls. of water) should be of sufficient strength when testing to cause the appearance of minute cracks after immersion for 2 seconds. The strength of the lye is then reduced till further tests produce cracking barely perceptible to the naked eye though the colour change should be the same as in the stronger solution. The fruit is dried on racks or trays and must be frequently turned to prevent the skin in contact with the tray from being injured or lacking brightness. Sun drying is conveniently done in $\frac{1}{2}$ in. netting racks for 6 or 7 days

* See also 434.

followed by 3 or 4 days on the trays. Prunes are sufficiently dry when they can be squeezed without any sign of juice and show an even, meaty condition to the stone. After drying prunes are sweated in heaps several feet high for 3 or 4 weeks and turned every 10-14 days. A finishing dip is not desired of the grower by the packers. They themselves supply that, if necessary, and duplications lead to a mixing of ingredients. The grower is credited with all the overrun that occurs when the packer finally processes the consignment to a definite moisture standard.

502. BURGER, I. J. 664.85.8.047
Sultana drying.
Fmg S. Afr., 1937, 12 : 53-5.

The method of drying employed to produce a light coloured, unbleached sultana should depend largely on the climatic conditions of the area. In this paper methods are recommended (1) for the Western Cape Province, an area with a relatively high humidity during the drying season and (2) for areas with a hot, dry climate. In both cases a mixed oil dip has so far given the best results. This is made by adding $1\frac{1}{2}$ lb. potassium carbonate + $\frac{1}{2}$ pint olive oil to every 30 galls. water in a dip tank, and then adding 1 lb. caustic soda. The solution is heated to 180° F. and some sultanas inserted, caustic soda being finally added, a little at a time, until slight cracks appear on the berries. The dip is then ready for use at temperatures varying not more than 5° F. above or below 180° F. The dipping period should be short. Following dipping and draining the bunches are air-dried on trays or wire-netting racks. In the case of moist districts the fruit is exposed to the sun, but in hot, dry areas protection from the direct rays of the sun is necessary. When sufficiently dry to shake down easily the sultanas are removed from the racks, spread in thin layers on hessian or on drying racks and exposed to the sun with as little handling as possible. After 1-2 days all traces of green colour are usually removed, but, in cases where the fruit is insufficiently bleached when dry, additions of moisture in the form of a spray or wash are necessary. A solution of 1 lb. potassium carbonate with $\frac{1}{2}$ pint olive oil in 20 galls. water is suggested for this purpose. The fruit is then exposed for further drying. Finally, preliminary sorting for colour is one of the essential steps to be taken on the farm.

503. CRUESS, W. V. 634.23-1.564.4 : 663.874.
Maraschino cherries.
Fruit Prod. J., 1937, 16 : 263-5, 277, 279, 281 and 283.

Methods of barrelling cherries in "brine" and of preparing dyed and flavoured cherries from the "brined" product, based to a large extent on the results of experiments carried out at the University of California, are described. Barrelling and brining are curing processes, whereby the colour is bleached through the agency of SO_2 or certain sulphites and the texture of the cherries made firm and tough by lime or some other calcium salt and possibly, in addition, by means of alum. The preparation of these solutions is described. For barrelling the variety most commonly used on the Pacific Coast is Royal Anne, but other white and some red and black varieties such as Black Tartarian and Bing are also suitable. The cherries should be picked somewhat unripe. In barrelling the stems are usually left attached, but may be removed provided curing is started before browning of the stem cavity occurs. The barrels should be stored in a cool warehouse when curing will be complete in 4-6 weeks. Subsequent treatments described include stemming, grading and pitting, the reduction of the SO_2 content from 1500-2000 p.p.m. or over to below 20 p.p.m., and dyeing with erythrosine or Ponceau —3—R dye.

504. BONNEY, V. B. AND ROWE, S. C. 635.656 : 631.547.6
Chemical studies on maturity of canned peas.
J. Ass. off. agric. Chem., Wash., 1936, 19 : 607-19, bibl. 2.

Analyses of canned peas from eleven States, consisting of 157 samples of Alaska peas and 159 samples, including 8 varieties of sweet [sugar?—ED.] peas, showed alcohol-insoluble solids to be an excellent index of maturity for both Alaska and sweet peas. With the exception

of one sample which showed alcohol-insoluble solids of 22·8%, alcohol-insoluble solids were below 22% in all samples of Alaska peas which were not quite mature. The corresponding figure for sweet peas was 19%. With Alaska peas no sample, with exception of those packed from mature peas, was found with over 5% of the peas so swollen as to rupture the skin more than $\frac{1}{8}$ in. Similarly no sample, other than those packed from mature peas, was found in which more than 17% of the peas sank in a brine of 1·12 specific gravity. With sweet peas even mature samples did not rupture appreciably when canned and only in a very few instances did any mature or immature peas sink when placed in brine of 1·12 specific gravity. [From authors' summary.]

505. ROWE, S. C. AND BONNEY, V. B. 635.65 : 631.547.6

A study of chemical and physical methods for determining the maturity of canned snap (stringless) beans.

J. Ass. off. agric. Chem., Wash., 1936, 19 : 620-8.

An investigation was undertaken in 1935 to obtain data which might prove useful in establishing a minimum standard of quality for canned stringless beans. 104 samples, representing 7 varieties from 7 different States were used in the determinations. The varieties and sources of the beans and the results of the examinations are tabulated, and methods developed to determine the maturity of the canned beans are described. Three charts are presented showing the correlations between the percentage fibrous material, the percentage seeds and the percentage alcohol-insoluble solids respectively and the grade of the product. The data obtained from the investigation indicate that standard beans should contain not more than 0·08% fibrous material in the pods, 6% seeds and 7% alcohol-insoluble solids, and that there should not be more than one tough string per 2 oz. drained weight of beans.

506. MARTIN, W. M. 663.813 : 634.23

Problems involved in packing cherry juice.

Fruit Prod. J., 1936, 15 : 166-8, 183, 185 and 187.

Methods of preparing cherry juice based on the results of two years' experimental work are described briefly. The problems discussed include methods of extracting colour from the fruit, the question of hot or cold extraction, means of clarification and the selection of fruit of suitable quality.

507. CRUESS, W. V. 663.815 : 634.31

Early experiments in preservation of orange juice.

Fruit Prod. J., 1936, 15 : 164-5.

Results of experiments made between 1914 and 1922 in the Fruit Products Laboratory at the University of California are summarized.

508. POE, C. F. 663.813 : 635.64

Further studies on the composition of commercially canned tomato juices.

Fruit Prod. J., 1936, 15 : 132-3, bibl. 5.

Results of the analysis of 19 samples of tomato juice obtained in the open market and representing the 1932 U.S. pack are tabulated in detail, and the average values of the samples are compared with those of 13 samples representing the 1931 pack.

509. OAKLEY, M. AND KRANTZ, J. C. 663.813 : 635.64

The buffer capacity of tomato juice.

Industr. Engng Chem., Anal. Ed., 1936, 8 : 205-6, bibl. 7.

The buffer capacity of 6 commercial samples of tomato juice has been measured with respect to strong acid. The Van Slyke β is 0·033. Added water does not markedly influence this

value. Tomato juices show considerable variation in their capacity to resist change in pH upon the addition of strong alkali. These values do not correlate well with normal differences found in total solids, salt content, ash, and refractive index. The buffer capacity of the serum with respect to added alkali diminishes with increased added water. It is possible to employ the measurement of buffer capacity corroboratively as means of detecting added water in tomato juice. [Authors' summary.]

510. STEPHENS, S. E. 663.39
Wines from tropical fruits.

Qd agric. J., 1936, 45 : 276-9 and reprinted in *Rhod. agric. J.*, 1936, 33 : 318-22.

Instructions are given for making wines from the following tropical and temperate zone fruits : orange (3 recipes), mango (2 recipes), granadilla, pineapple, mulberry, strawberry (2 recipes), raspberry, rosella (2 recipes) and raisins.

511. WALSH, W. F. AND TRESSLER, D. K. 635.48 : 663.819
Beverages from rhubarb.

Fruit Prod. J., 1936, 15 : 262-3, bibl. 5.

Pleasant beverages can be made by diluting clarified rhubarb juice for a cost of less than 10 cents a gallon. A method of preparing the juice is outlined, and reference is made to a previous paper in which a method of carbonating the juice is described. Of several varieties tested [apparently in New York State—Ed.] Victoria and Strawberry, the two commonest types, have proved entirely suitable, and Ruby has been found of value in imparting red colour to the finished product. The so-called Pineapple variety, however, possesses less of the characteristic flavour than do the first two varieties mentioned. Rhubarb juice also blends well with most other fruit juices and some of the combinations found satisfactory are noted here.

512. PULLEY, G. N. 634.3 : 581.192.
Solubility of naringin in water.

Industr. Engng. Chem., Anal. Ed., 1936, 8 : 360, bibl. 9.

Little increase was achieved in the solubility of naringin prepared from grapefruit peel by increasing the temperature from 6° C. up to 45° C. From 45° C. to 83° C. (the melting point, when naringin is crystallized from water and possesses an additional 6 molecules of water) the solubility was found to increase rapidly with increased temperature.

513. BLACKIE, W. J. 633.85
Candlenut oil.

Agric. J. Fiji, 1936, 8 : 36-42.

The industrial and economic value of candlenut oil (*Aleurites moluccana*) is discussed. It is considered that, as the oil can replace linseed oil for all purposes, while if used in paint it dries 4 hours quicker than linseed oil, it could find a profitable market, provided the price were lower than that of linseed and supplies were regular. The chief difficulty in exploitation is the difficulty of shelling the nuts without breaking the kernels into small pieces which often adhere to the shell. Experiments in pre-treatment designed to overcome this are described :—(1) the shell can be softened by treatment followed by immersion in cold water ; (2) a temperature of more than 100° C. leads to burning ; (3) boiling with water (100° C.) permits the easy removal of the kernel from the shell leading to a greater percentage of whole and half nuts and little residue. The work, however, was too tedious for the local labour. A small decorticating machine was obtained and methods of pretreatment modified in some degree from the original ones were used. Pretreatments proving most successful were heating to 200° F. for 3 hours and cooling by water for 3 or 2 hours or by air for 12 hours. The efficiency of the machine

was not pronounced but about 6% of whole kernel was obtained and up to 16% including broken kernels. Work is now concentrated on machine improvement to obtain a greater yield of whole kernels, on investigating methods of clean separation of shell from kernel, and on oil extraction with and without decortication.

514. FLEMONS, G. F. AND HARWOOD, L. W. 634.61-1.56
Small copra driers.
Agric. J. Fiji, 1936, 8 : 8-10.

A description, accompanied by working plans for construction, is given of a small copra drier, of a type used in Malaya but modified to suit Fijian conditions. The model is proving very popular since the Fijians are realizing that it enables them to produce good copra instead of having to sell it wet or partially dried at depressed prices. Instructions are also given for using the drier.

515. BANZON, J. 634.61 : 665.3
Studies on coconut oil : I. Pyrolysis.
Philipp. J. Agric., 1937, 25 : 817-832, bibl. 17.

A study of the decomposition of coconut oil when treated in the presence of catalysts. The distillation range of the treated oil samples was brought down to low figures but was still too high to give a high yield of liquids of motor fuel range. About 20-50% are within kerosene range.

516. BUCKLEY, T. E. 634.6
The dietetic value of palm oil.
Malay. agric. J., 1936, 24 : 485-8, bibl. 7.

Red palm oil, i.e. unbleached oil, is found to be about equal to cod liver oil in its vitamin A activity, though it is almost devoid of vitamin D. Notes on analytical data are given, and their possible bearing on the stage of maturity at which the fruit should be picked is discussed.

517. DAMODARAN, M. AND SIVASWAMY, T. G. 634.573 : 581.192
A new globulin from the cashew nut (*Anacardium occidentale*).
Biochem. J., 1936, 30 : 604-8, bibl. 8.

A new globulin, for which the name anacardein is suggested, has been isolated from cashew nuts, *Anacardium occidentale*, in yields amounting to 17 to 18% of the fat-free seed. The protein has been analysed by the method of nitrogen distribution and shown to be a biologically complete protein. Cystine has been determined colorimetrically and tyrosine by bromination. [Authors' summary.]

NOTES ON BOOKS.

518. GRESHAM PUBLISHING COMPANY. 634/5
Modern Garden Craft.
Gresham Publishing Co., London, 1936, 3 vols., 45s.

The work is stated in the preface to be in the nature of a complement to the *Gardener's Assistant*, that prominent work on English horticulture, which first seeing the light in 1859 has in a series of editions and under various distinguished editors been the oracle of British gardening ever since. *Modern Garden Craft* aims at reinforcing the older work particularly in those subjects in which recent scientific research has been active, and, so long as we remember that it is only reinforcement, there is no need to cavil. Nevertheless it is to be regretted that the reinforcements are sometimes so meagre as to contribute little to the strength of the original body.

Following the plan of the *Gardener's Assistant* each subject has been dealt with by a recognized authority. We would say the recognized authority, only opinions so often differ. But whether "the" or "a", the contributors are all men of mark in their respective provinces, possessing not only the knowledge but the power of imparting it. And if some of them have failed satisfactorily to compress their subject into the few pages allotted to them, others have succeeded to perfection. As outstanding examples of how to get quarts into pint bottles we must cite R. B. Dawson's "Making and Management of Lawns and Sports Grounds," H. V. Taylor's "Vegetable Production for the Markets" and T. Wallace's dissertation on soils. Dr. Wallace, indeed, must have suffered severely at having to cram so much into so little, but, whatever his feelings, those of his readers can only be of admiration. Space will not admit of a list of the contents, it suffices to say that every horticultural subject has been covered more or less and, if less, the missing information can usually be obtained from the *Gardener's Assistant*. The book does not profess to be an encyclopædia but for general horticultural readers it is of value and both style and type are pleasant. The spelling of plant names is evidently not the forte of the indexer.

519. MASSEE, A. M.

632.6/9 : 634.1/8 + 633.79

The pests of fruits and hops.

Crosby Lockwood, London, 1937, octavo, pp. 294, bibls. numerous, 15s.

In his introduction the author stresses the fact that nowadays mycologists, entomologists, chemists, and pomologists work as one team and very often in the same laboratory. And so this book, by an entomologist of renown, is primarily addressed to what we may call the practising pomologist or in other words the practical fruitgrower of this country. Anyone wanting to determine the number of hairs on the cauda of, say *Amphorophora sonchi* Oest. will search in vain, but if he or she wants to know how *A. sonchi* Oest, alias the currant and lettuce aphid, affects currants and lettuce and how it can be controlled, then here is the book to consult. The insects are dealt with under the fruits attacked, and after each insect, or group of insects, a note of control measures and a bibliography of articles dealing with these insects are given. Many of the insects are illustrated with very clear, useful photographs by R. M. Greenslade. The 26 plates, averaging 3-4 illustrations each, are in fact, so good that one sighs for even more. Again the short bibliographies referred to above make one wonder whether it would not have been also worth while to collect all of them into one central bibliography. Still, as now placed, these references are very convenient for anyone wishing to study a particular pest more thoroughly, and an author index at the end enables one to run down any given authority without trouble. Indexes of both popular and scientific names of insects are also available. But to include illustrations of every pest, to add a comprehensive bibliography and in fact cater for every whim of every possible reader, would have made the work too bulky for anything except a library and would have rendered its cost prohibitive to most of those for whom it was intended and for whom it so excellently caters. After the harmful insects of fruits and hops have been dealt with, a section follows on beneficial and harmless insects. Finally Turnbull contributes a valuable chapter on spraying equipment and methods, in which he stresses the essential points which must be borne in mind when employing the various systems. Here in this well-filled book are the results of the prolonged research and careful observation of the leading practical entomologists of the day on the incidence and control of our deciduous orchard pests. The exclusion of what has been rudely called "scientific jargon" makes it no less useful to the expert and infinitely more so to the layman. To both it can be confidently recommended.

520. LUCKAN, J.

634.75

***Erdbeerbuch.* (The book of the strawberry.)**

Rud. Bechtold, Wiesbaden, 1937, pp. 71, R.M. 2.50.

This short book by a student of the great strawberry breeder, Schindler, is a manual for the grower and contains advice on the many ordinary practical problems which are likely to beset him. After briefly discussing the history of the strawberry since the first introduction into

Europe from Concepcion of *Fragaria chiloensis* by Frézier in the year 1712, and its environmental requirements, the author describes the characteristics of some 22 ordinary varieties known in Germany (including several well-known in England) and a number of everbearing varieties. Next he discusses propagation by runners and by seed, methods of keeping strains pure and the breeding of new varieties. Planting, cultivation methods and manuring are briefly considered and the best methods of establishing young plants. The technique of packing young plants for sending away, and for packing and marketing fruit are discussed with notes on varietal susceptibility to market handling. A note is given on growing early berries under glass. Finally some 6 pages are devoted to pests and diseases and control directions are given, though the latter are of a general nature and might well be expanded.

521. INTERNATIONAL INSTITUTE OF AGRICULTURE. 631.874
Use of leguminous plants in tropical countries as green manure, as cover and as shade.

Internat. Inst. Agric., Rome, 1936, pp. 262, 10 liras It.

In this survey the International Institute of Agriculture adds one more to the list of useful compilations with which it all too occasionally, we think, more than justifies its existence, and it must be admitted that once the Institute does get its teeth into a subject it will not let go till it has shaken the last shred of information out of it. The normal procedure is to issue a questionnaire to the competent authorities in all countries likely to be in possession of the information required. In this case while information was received from 93 agricultural organizations in 43 countries the compiler laments many lacunae. Nevertheless to those who have had experience in the sending out of questionnaires of this nature it will seem that he has done pretty well. The work opens with a valuable contribution by Sir John Russell in the form of a general survey of the use of green manures. Succeeding chapters, each with its bibliography, deal with the characteristics of tropical soils, the advantages and disadvantages of green manuring (the latter occupying one page only), general methods of use, and uses in relation to the principal tropical crops, here treated singly, and finally a list of leguminous plants employed in various tropical countries. "List" is the Institute's word, we should call it an annotated catalogue, for under the name of each of the 261 plants mentioned are given all the countries where it is used, with copious notes on use, behaviour, etc. in each locality. These alone would make the publication worth while. The work is obviously one which no one concerned with tropical agriculture, especially on the experimental side, should be without, since between its (paper) covers it contains what must be practically the whole of modern knowledge on green manuring whether scientific or empirical.

522. HOARE, A. H. 635.1/7
Vegetable crops for market.

Crosby Lockwood, London, 1937, pp. 198, 7s. 6d.

This book forms one of the series of useful Agricultural and Horticultural Handbooks now being issued in quick succession by Messrs. Crosby Lockwood & Son, and it is by no means the least important. The work deals with the whole range of commercial vegetable growing both on the intensive and extensive systems, and, in view of the fact that agricultural depression has of recent years driven the ordinary farmer to take an interest in these crops, the information on the latter system is particularly timely. The book opens with chapters on the economic aspect, on soil and cultural methods in general, on seeds and plant breeding. Succeeding chapters are devoted to *Brassica* crops, leguminous crops, root crops, salad crops and so on, and within each chapter the different vegetables of the group are treated separately. Principal pests and diseases are described in an appendix, but no attempt is made to tell the grower how to cope with them. He is instructed instead at the first sign of trouble to call in his county adviser and everyone, except perhaps these already overworked gentlemen, will agree that the idea is a good one. There are also appendices giving condensed information on the composition of fertilizers and on the nature and size of the principal containers used in marketing.

523. FLOOR, J. AND ZWEEDE, A. K. 634.11-1.541.12
*Handleiding voor de determinatie van appelonderstammen. (Handbook for the
 identification of apple rootstocks.)**

Nederlandsche Algemeene Keuringsdienst ("N.A.K."), Wageningen, 1937, pp. 32.

The object of this handbook is to render possible the identification of apple rootstocks from normal year-old shoots such as are to be found in the propagating beds. This is done by means of a key to the summer characters of the types, a description of each type in which the differences distinguishing it from others are pointed out, photographs of leaf, leafy shoots, and wood of each type, and a briefer description of winter characters. The characters relied on to supply the distinctions are ratio of leaf length to breadth, shapes of leaf base, and apex angle, degree of pubescence, colour of wood on the shaded side, comparative size ratio of stipules and petioles, nature of leaf margin, few or many lenticels. Examples are given of how to use the handbook to the best advantage. It is pointed out that the rootstock types described are identical with the East Malling types. There is a foreword by Dr. A. M. Sprenger under whose auspices the work was carried out.

* Translation available.

